A **Survey of Potential Marine Reserve Locations in Bass Strait**

Final Report
Ocean Rescue 2000 Project D701
For Australian National Parks and Wildlife Service

Contents

Abstract

The Tasmanian north coast, King Island, and Tasmania's eastem Bass Strait Islands were quantitatively surveyed to identify locations suitable for the establishment of regional marine reserves in Bass Strait. This survey included a re-assessment and further investigation of Rocky Cape and the Kent Group, two locations previously proposed as marine reserves. The Kent Group was identified as the most outstanding location surveyed, with a range of habitats and biota representative of Bass Strait, and including a significant proportion of Peronian species. Biologica11y this location would be the preferred location for a marine reserve in the Peronian influenced region of Tasmania. Rocky Cape was identified as the most biologica11y suitable location on Tasmania's n0l1h coast due to its diverse range of habitats and species abundance. After Rocky Cape, the next two most desirable locations in the Bass Strait region for marine reserves were considered to be Waterhouse Island in n011heast Tasmania and New Year Island off the n011h west coast of King Island.

General Introduction

The need for improved management of marine resources is gradually being recognised as coastal marine resources decline locally and world-wide. Unfortunately the restrictions on fishing effort necessary to arrest this decline are often long overdue, because the long term baseline studies necessary to objectively assess the extent of any changes have not been undertaken.

While the decline of Tasmanian coastal fauna is poorly documented, the few studies available (eg. Schaap and Green, 1988; Harries and Croome, 1990) indicate that reef fish communities especially are presently under serious threat due to the impact of gillnet fishing, and have suffered a substantial decline over the last 100 years. While this decline may eventually be reversed by appropriate management measures, the establishment of a network of marine reserves around the Tasmanian coastline may be the simplest and most effective form of insurance against fisheries collapse.
Reserves have consistently been found to enhance both numbers and average size of many marine species (Roberts and Polunin, 1991), with the greatest change being evident amongst heavily exploited species (Cole, Ayling and Creese, 1990).

In addition to simply conserving the resource, marine reserves also offer a number of other important benefits (Ballantine, 1991) These include:
1. The moral and aesthetic value of preserving small sections of our coastline in their natural state.
2. Recreational and tourism attraction.
3. Educational benefits of providing locations where children and adults can learn about our coastal ecosystems and the importance of conserving marine resources.
4. Scientific studies. Marine reserves act as a reference or baseline to which changes in adjacent fished areas can be compared. Experiments within reserves can also be used to predict the impact of different management strategies being developed for the rest of the State.
5. Enhanced recruitment to adjacent areas. Because most species of marine flora and fauna have dispersive stages in their life history, marine reserves act as a "seed" source, replenishing adjacent areas.

At present there are 4 marine reserves in Tasmanian waters covering less than 0.2% of the coastline (although there are also a number of small special purpose research areas, and areas protected for waterbird sanctuaties; Ivanovici, 1984). These were declared in 1991 following some of the recommendations in two Tasmanian National Parks and Wildlife Service surveys of Tasmania's marine park potential (Edgar, 1981, 1984). Edgar recommended marine reserves be established at Ninepin Point and Tinderbox in the D'Entrecasteaux channel, Maria Island and Bicheno on the east coast, the Kent Group of islands in eastern Bass Strait, and at Rocky Cape in western Bass Strait. Three of the reserves declared in 1991 are identical to the original proposals of Edgar (Tinderbox, Ninepin Point, and Bicheno), while the area subject to fishing restrictions at Maria Island is presently half the size of the original proposal. The proposals for reserves at the Kent Group of

islands and at Rocky Cape were not proceeded with, at least partly in response to strong local opposition to a reserve at Rocky Cape.

The Tasmanian coastline is influenced by three separate ocean current systems and this is reflected by its coastal biota which can be loosely categorised into 3 major biogeographic regions. These include a region with an entirely Maugean (Tasmanian) biota including most of the west, south and east coasts; a region with a component of Flindersian (Southern Australian) species including most of Bass Strait; and a region with a component of Peronian (New South Wales) species, restricted to the eastern extremity of Bass Strait.

While the Maugean province biota appears well represented by the present reserves, the Flindersian and Peronian biota remain unprotected. In this study, the shallow reef flora and fauna of the Tasmanian north coast and Bass Strait islands were surveyed to identify priority areas for reserve status. The survey techniques were chosen to be as quantitative as possible so that the results may also be useful as baseline data by which to measure the progress of any reserve if established, and to also act as general baseline data for coastal managers.

Methods.

Choice of survey sites: This survey was restricted to rocky reef habitats, as temperate reef communities are among the most threatened biota in Tasmanian waters at present. Due to the extensive stretches of sand along the Tasmanian north coast, and heavy industrial pollution of the central north coast, the choice of survey sites was restricted to the rocky headlands of the northeast and northwest coasts as well as offshore islands.

Survey techniques: Each survey included the quantitative estimation of diversity and abundance of fish, major macrofaunal invertebrates and macroalgae, at as many sites as possible within areas identified as having reserve potential. The methods were chosen to make the survey as quantitative as possible, allowing reliable comparisons to be made between sites and providing a suitable baseline data set that would be valuable to to coastal managers. As these techniques are also in use in the on-going monitoring of the four existing marine reserves they will allow for direct comparison of the results of both studies.

At each site, three methods were needed to adequately census the abundance and size structure of fishes and benthic invertebrates, and the percentage cover of macroalgae. The technique considered most appropriate for censusing large fishes consisted of laying four replicate 50 m transect lines along the 5m (and on three occasions 10m) depth contour and recording the number and estimated size of fish observed by a diver while swimming along the centre of a 5m wide swathe on either side of the line. 5m was considered the optimum depth strata for several reasons: (i) few reefs in the Rocky Cape and Waterhouse Point regions extended below 6m, (ii) shallower habitats were difficult to sample because of steep slopes in some areas and wave turbulence, (iii) diving times were not limited by decompression schedules, and (iv) reefs at 5m are subjected to heavy netting and spear

fishing pressures. Smaller and cryptic fishes and megafaunal invertebrates (large molluscs, echinoderms, crustacea) were also counted along the 4 x 50m transect lines used for the fish survey by counting benthic organisms inside a 1m wide strip alongside the line. The maximum length of abalone and carapace length of rock lobster were measured underwater using calipers as these species were encountered. The cover of macroalgal species was then determined by placing 0.5 x 0.5 m^2 quadrats at 10 m intervals along the transect line, and, using a points method, determining the percentage cover of the various plant species.

Analysis: The complete results of this survey are presented as an appendix to this report, and comprise all details of each site surveyed including length estimates of fish and abalone, and counts per transect. These results are presented as simplified tables within the report, where the individual counts per transect are pooled to give a total count per site.
The Shannon diversity index was calculated for the fish communities at each site using

$$H = -\sum_{i=1}^{s} (p_i)(\log_2 p_i)$$

where:
H = index of species diversity
S = number of species
p_i = proportion of total sample belonging to the ith species. (From Krebs, C., 1985)
Counts of large schools of mobile and pelagic species were not included in this calculation.

A cluster analysis was also produced from the fish counts to examine the similarity between sites. This cluster was produced using the Pearson correlation coefficient average linkage method, calculated using SYSTAT® version 5.1 with log transformed data.

Common Names of Fish			
Species:	Common name:	Species:	Common name:
Acanthaluteres spilomelanurus	Bridled Leatherjacket	*Meuschenia flavolineata*	Yellow-tailed Leatherjacket
Achoerodus gouldii	Western Blue Groper	*Meuschenia freycineti*	Six-spined Leatherjacket
Apogon conspersus	Southern Cardinal fish	*Meuschenia hippocrepis*	Horseshoe Leatherjacket
Atypichthys strigatus	Mado Sweep	*Meuschenia venusta*	Stars and Stripes Leatherjacket
Bovichthys variegatus	Dragonet	*Neoodax attenuatus*	Slender Rock Whiting
Caesioperca lepidoptera	Butterfly Perch	*Neoodax balteatus*	Little Rock Whiting
Caesioperca rasor	Barber Perch	*Neoodax beddomei*	Pencil Rock Whiting
Cephaloscyllium laticeps	Draughtboard Shark	*Norfolkia striaticeps*	Macleay's Threefin
Cheilodactylus nigripes	Magpie Perch	*Notalabrus fucicola*	Purple Wrasse
Cheilodactylus spectabilis	Banded Morwong	*Notalabrus tetricus*	Blue-throated Wrasse
Chromis hypsilepis	One-spot Puller	*Odax acroptilus*	Rainbowfish
Cyttus australis	Silver Dory	*Odax cyanomelas*	Herring Cale
Dactylophora nigricans	Dusky Morwong	*Ophthalmolepis lineolatus*	Moari Wrasse
Dactylosargus arctidens	Marblefish	*Parascyllium ferrugineum*	Rusty Catshark
Dasyatis brevicaudatus	Smooth Stingray	*Parascyllium variolatum*	Varied Catshark
Dinolestes lewini	Long-finned Pike	*Parika scaber*	Velvet Leatherjacket
Diodon nichthemerus	Globefish	*Parma microlepis*	White Ear
Dotalabrus aurantiacus	Castelnau's Wrasse	*Parma victoriae*	Scalyfin
Ellerkeldia maccullochi	Half-banded Sea Perch	*Pempheris multiradiatus*	Common Bullseye
Enoplosus armatus	Old Wife	*Penicipelta vittiger*	Toothbrush Leatherjacket
Eubalichthys gunnii	Gunn's Leatherjacket	*Pentaceropsis recurvirostris*	Long-snouted Boarfish
Girella elevata	Black Drummer	*Pictilabrus laticlavius*	Senatorfish
Gnathanacanthus goetzii	Red Velvetfish	*Pseudophycis bachus*	Red Cod
Haletta semifasciata	Blue Rock Whiting	*Pseudophycis barbatus*	Bearded Rock Cod
Heteroclinus forsteri	Forster's Weedfish	*Raja whitleyi*	Whitley's Skate
Heteroclinus johnstoni	Johnston's Weedfish	*Sardinops neopilchardus*	Pilchard
Heterodontus portusjacksoni	Port Jackson Shark	*Scorpaena ergastulorum*	Common Red Rock Cod
Hypoplectrodes nigrorubrum	Black-banded Sea Perch	*Scorpis aequipinnis*	Sea Sweep
Kyphosus sydneyanus	Silver Drummer	*Scorpis lineolatus*	Sweep
Latridopsis forsteri	Bastard Trumpeter	*Sepia apama*	Giant Cuttlefish
Latropiscis purpurissatus	Sergeant Baker	*Siphamia cephalotes*	Wood's Siphonfish
Lotella rhacinus	Beardie	*Siphonognathus sp.*	Siphonfish**
Melambaphes zebra	Zebrafish	*Trachinops caudimaculatus*	Blotch-tailed Trachinops
Meuschenia australis	Brown-striped Leatherjacket	*Upeneichthys vlaminghii*	Western Red Mullet
		Urolophus paucimaculatus	Sparsely-spotted Stingaree
			**No common name

Table 1. Fish and cephalopod species encountered during the Bass Strait survey with their common names.

Common Names of Invertebrates	
Species:	Common name:
Echinoderms	
Amblypneustes grandis	Short-spined Sea Urchin**
Amblypneustes sp.	Short-spined Sea Urchin**
Astrostole scabra	Sea Star**
Austrofromia polypora	Sea Star**
Centrostephanus rodgersii	Roger's Sea Urchin
Comanthus tasmaniae	Feather Star**
Comanthus trichoptera	Feather Star**
Coscinasterias calamaria	Eleven-armed Sea Star
Echinaster arcystatus	Dimpled Sea Star
Goniocidaris tubaria	Pencil Urchin
Heliocidaris erythrogramma	Sea Urchin**
Holopneustes inflatus	Inflated Sea Urchin
Holopneustes porossimus	Red-spined Sea Urchin
Nectria macrobranchia	Large-plated Sea Star
Nectria ocellata	Ocellate Sea Star
Nepanthia troughtoni	Unnamed Sea Star
Paranepanthia grandis	Grand Sea Star
Pateriella calcar	Spurred Sea Star
Patiriella brevispina	Short-spined Sea Star
Pentagonaster duebeni	Vermillion Biscuit Star
Petricia vernicina	Velvet Sea Star
Plectaster decanus	Mosaic Sea Star
Stichopus mollis	Soft Sea Cucumber
Tosia australis	Southern Biscuit Star
Tosia magnifica	Magnificent Sea Star
Uniophora granifera	Starfish**
Molluscs	
Argobuccinium vexillum	Flag Triton
Cabestana tabulata	Ploughed Rock Whelk
Cabestana waterhousi	Waterhouse's Rock Whelk
Charonia rubicunda	Red Triton
Chlamys asperimus	Doughboy Scallop
Haliotis emma	Emma's Ear Shell
Haliotis laevigata	Greenlip Abalone
Haliotis rubra	Blacklip Abalone
Mayena australiasia	Australian Rock Whelk
Penion mandarinus	Mandarin Whelk
Penion maxima	Great Whelk
Pleuroploca australasia	Tulip Shell
Sassia sp.	Rock Whelk
Sepia apama	Giant Cuttlefish
Thais orbita	Dog Winkle
Turbo undulatus	Periwinkle
Crustacea	
Jasus edwardsii	Southern Rock Lobster
Nectocarcinus tuberculatus	Rough Rock-crab
Pagurid sp.	"Grey" Hermit Crab**
Paguristes sp.	"Red" Hermit Crab**
Plagusia chabrus	Red Bait Crab
	**No common name

Table 2. Invertebrate species encountered during the Bass Strait Survey with their common names

Results

Survey 1. Waterhouse to Cape Portland (North East Tasmania).

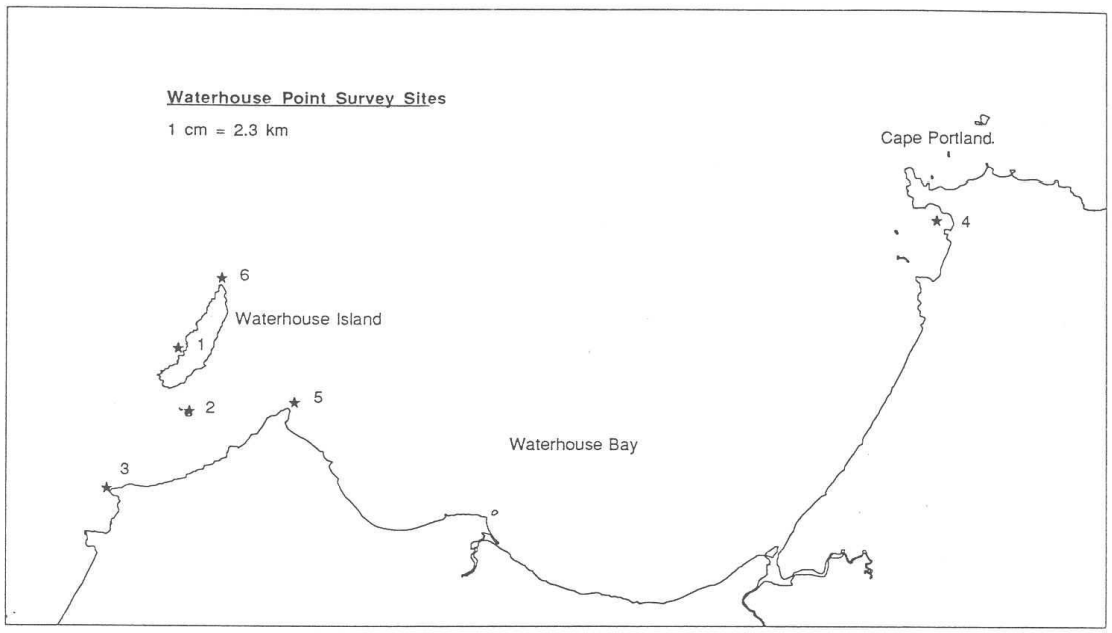
Introduction: As most of the northeast Tasmanian coastline consists of sandy beaches this survey was restricted to the vicinity of the two major rocky headlands, Waterhouse Point and Cape Portland. Both these areas are remote from major population centers and are difficult to gain access to. The Waterhouse Point access tracks are sandy and require 4wd vehicles for safe access and boat launching, with the nearest available boat launching ramps at Bridport and Tomahawk, both 15km away by water. Access to Cape Portland is restricted as the road crosses private property. The nearest public access is at Petal Point on the western side of Cape Portland. Boat launching facilities are available at Little Musselroe Bay 7km away by water. While both areas are sparsely populated during winter they are popular camping areas during summer.

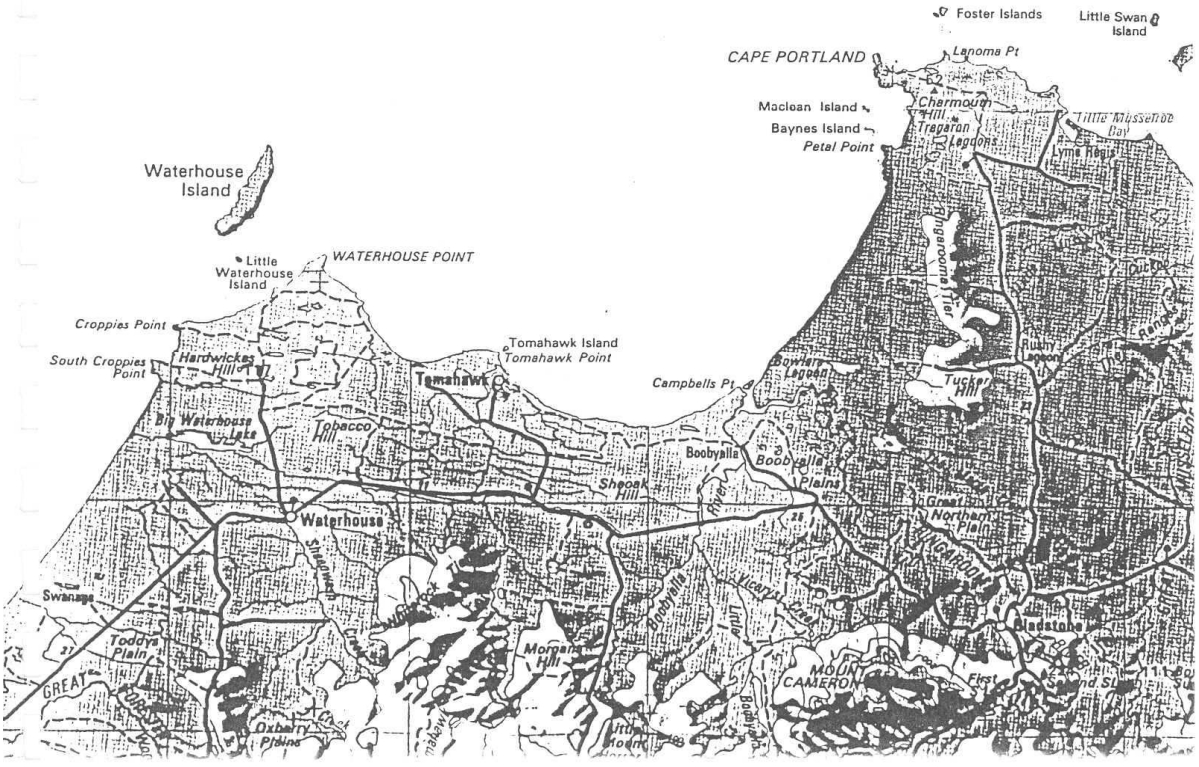
Geology: The Waterhouse Point area consists of a series of rocky points outcropping from an extensive dune system. The two westernmost points, Croppies and South Croppies, are composed of Jurassic dolerite, while the larger Waterhouse Point consists of course grained granite. The two offshore islands, Waterhouse and Little Waterhouse, are Jurassic dolerite. The reef systems around each point extend subtidally to approximately 5m maximum depth and have little offshore development. Waterhouse Island appears to have a more extensive reef system on its west to northwest coasts which may extend into depths greater than 10m.

Cape Portland is composed mostly of Jurassic dolerite, with an outcrop of Tertiary basalt in the bay to the east of the cape. The reef system around Cape Portland is poorly developed offshore and extends to sand and seagrass at depths of between 2 and 5m.

Fish: Six sites were surveyed in the Waterhouse Point to Cape Portland survey, (Fig. 1) and the remaining reef systems were investigated to determine their extent of offshore development and depth range. The results of the fish survey are shown in table 3 where the fish counts for the 4 transects within each site are pooled. A total of 29 species were encountered during the fish transects while a further 3 cryptic species were encountered during the invertebrate transects (table 4). The number of species encountered at each site ranged between 8 to 21 and appeared similar to the range encountered during the Rocky Cape Survey. The fish community was dominated by *Notolabrus tetricus* at all sites, while *Pictilabrus laticlavius, Neoodax beddomei*, and *Penicipelta vittiger* were present at all sites and locally abundant. All of these species have a widespread distribution. Other locally abundant species included *Meuschenia*

Figure 1. Regional map and site locations for the Waterhouse Point to Cape Portland survey





hippocrepis, Odax cyanomelas, Neoodax balteatus, Melambaphes zebra, Scorpis aequipinnis, Enoplosus armatus, Parma victoriae, Dotalabrus aurantiacus, Acanthaluteres spilomelanurus, and Cheilodactylus nigripes. Of the 32 species encountered during the fish and invertebrate transects, 22 were species with widespread distributions, while 10 were species whose Tasmanian distribution is restricted to Bass Strait and the north coast. These included *Heterodontus portusjacksoni, Melambaphes zebra, Scorpis aequipinnis, Enoplosus armatus, Odax acroptilus, Meuschenia flavolineata, Meuschenia hippocrepis, Cheilodactylus nigripes, Parma victoriae,* and *Dotalabrus aurantiacus.* All of these species have distributions which encompass both the Peronian and Flindersian Marine provinces, with the exception of *Parma victoria* which is more typical of the Flindersian province.

Invertebrates: Four sites were surveyed for megafaunal invertebrate abundance in the Waterhouse Point to Cape Portland region (fig. 1, sites 1-4). 27 species were detected in the overall survey with a range of 11 to 14 species per site (Table 4). The megafaunal community was usually dominated by *Heliocidaris erythrogramma* and *Comanthus trichoptera,* while *Thais orbita, Plagusia chabrus, Haliotis rubra, Tosia australis, Plectaster decanus* were common and present at all sites. Of the 27 species detected, 23 have a widespread distribution, while four species *Patiriella brevispina, Plectaster decanus, Haliotis laevigata* and *Haliotis emma* are found only in northern Tasmanian waters. *Haliotis laevigata* and *H. emma* appear to be restricted to waters influenced by the Flindersian marine province.

Macroalgae: Four sites were surveyed for percentage cover of macroalgae (sites 1-4, Fig. 1). 38 species of macroalgae were identified in the survey while the total species present at each site ranged from 16 to 26 (Table 5). *Acrocarpia paniculata* was the dominant macroalgae at each site while *Cystophora moniliformis, Seirococcus axillaris, Perithalia caudata, Sargassum varians, Zonaria turneriana,* and corraline algae were common and present at all sites. Most of the macroalgal species encountered are recorded as having widespread distribution (Wommersley, 1983, 1987) although 5 species are limited in their Tasmanian distribution to the north coast. These were *Sargassum heteromorphum, Xiphophora chondrophylla, Sargassum varians, Cystophora siliquosa,* all species with a predominantly Flindersian distribution, and *Cystophora monilifera,* a species found throughout Southern Australia.

Habitats: With the exception of the deeper reefs extending offshore from western and northern shores of Waterhouse Island, most of the available reef area within the Waterhouse to Cape Portland region is restricted to shallow reef no deeper than 5m. The macroalgal date indicates that the sites within the survey area are of slight to moderate exposure. There is a virtual absence of high energy coastline species such as *Phyllosphora comosa* and *Ecklonia radiata,* while the *Cystophora* and *Sargassum* species which are usually abundant is sheltered areas were also absent. This observation

is substantiated by the invertebrate data which is dominated by *Heliocidaris erythrogramma,* a species not encountered at high densities on high energy coastlines. Most of the reef area surveyed was bordered by seagrass, with the exception of the sites on western and northern Waterhouse Island, and there appears to be extensive seagrass patches on the eastern side of Waterhouse Island, the eastern side of Waterhouse Point, and around Cape Portland.

Summary of Waterhouse to Cape Portland survey.

1. The rocky reef habitat was found to be mostly restricted to shallow reefs of 5m depth or less, subject to slight to moderate exposure. The extent of reef coverage in the area is minimal as most of the coastal reef extends less than 50m offshore before descending to sand or seagrass. The notable exception to this is the western to northern coasts of Waterhouse Island which appear to have more extensive reef development and reefs which extend to greater depths than the surrounding area.
2. The biota encountered during the survey had a large component of species not generally encountered south of Bass Strait, and not presently represented in the existing marine reserves. These included 10 fish species, 4 megafaunal invertebrate species and 5 macroalgal species.
3. While the majority of species encountered were those with a widespread distribution, the remainder consisted of species with either a general Bass Strait and southern Australian distribution or those with a more Flindersian bias. There was no evidence of a Peronian influence on the biota.
4. Waterhouse Island appears to be the most favourable location for a marine reserve in the survey area as it offers a wide range of habitats from deep reef to shallow reef, and from the sheltered seagrass beds on the eastern side to the exposed coastline of the western side. It also offers the longest section of unbroken reef habitat in the region, as the remainder of the coastline consists of small isolated rocky headlands separated by long sections of sandy beaches.

Tasmanian North Coast and King Island Fish Survey																		
Location		Waterhouse Point						King Island						Rocky Cape				
	site	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5
Species	code																	
Acanthaluteres spilomelanurus	85			2		10												
Bovichthys variegatus	68																1	
Caesioperca rasor	25	1	3	2			28			1				136	15	3	5	40
Cheilodactylus nigripes	49	27	7	15		18	19	1	13	19			1	11	9	17	25	5
Cheilodactylus spectabilis	50	1					4		4	2							3	
Dactylosargus arctidens	48	3				1	2		1				2					
Dasyatis brevicaudatus	107													1				
Dinolestes lewini	28							5			20						466	
Diodon nichthemerus	98			2						3				2	1	2	5	
Dotalabrus aurantiacus	56	2	2		1	16	1											4
Enoplosus armatus	43	6		5		13	11	1		2							3	
Eubalichthys gunnii	87						1									1		
Girella elevata	36									1								
Heterodontus portusjacksoni	1		1	2														
Hypoplectrodes nigrorubrum	110														1			
Latridopsis forsteri	53	1															1	
Melambaphes zebra	39	58	6			12	9		2	2						2	2	
Meuschenia australis	88	6	2			5			1	2	1			3	3	3	1	8
Meuschenia flavolineata	89	3	1	1										2				
Meuschenia freycineti	90													2		1	3	1
Meuschenia hippocrepis	91	21	24	9		11	5		1					1			6	1
Neoodax balteatus	63		36		3	2				1				1	3	2		
Neoodax beddomei	64	10	50	27	68	83	60	19		1	1			2	31	4	12	41
Notalabrus fucicola	58		6					1	10	40	6			2	1	2	7	15
Notalabrus tetricus	60	330	116	113	45	217	167	44	164	270	51	35	20	170	69	63	58	91
Odax acroptilus	61	1	7			4	4	5	1	1								1
Odax cyanomelas	66	6	10	4		3	21	2			4				1		24	4
Parascyllium variolatum	105											1						
Parma victoriae	47	15	4	9	1	10	3		2	27				2	4	1	2	
Pempheris multiradiatus	35			80		1				3					540	1218	486	107
Penicipelta vittiger	93	27	29	3	2	9	15	2		2					6	2	9	6
Pentaceropsis recurvirostris	44					1								1			3	1
Pictilabrus laticlavius	57	7	16	10	2	34	7	6	1	22				4	8	9	4	3
Pseudolabrus psittaculus	59							1						18	7		2	11
Pseudophycis bachus	9													1			1	1
Pseudophycis barbatus	10												1					
Raja whitleyi	109																	1
Scorpis aequipinnis	40	21	2	16		10	3		21	17			63		3	1	44	10
Scorpis lineolatus	41					10	4										10	
Sepia apama	251								1									
Trachinops caudimaculatus	27													42	256	97	76	72
Upeneichthys vlaminghii	34				5	1		1						2	2	4		3
Urolophus paucimaculatus	108													1				
Total number of species:		19	18	16	8	21	18	12	13	18	6	2	5	20	18	18	26	21
Diversity index (H)		2.3	3.05	2.73	1.62	2.84	2.77	2.33	1.49	1.99	1.56	0.18	1.1	1.97	2.81	2.51	3.5	2.96

Table 3. Species abundance per site for fish and cephalopods encountered during the King Island, Rocky Cape and Waterhouse surveys.

Tasmanian North Coast and King Island Invertebrate Survey															
Location:		Waterhouse Point				King Island					Rocky Cape				
	site	1	2	3	4	1	2	3	4	5	1	2	3	4	5
Species:	code														
Cryptic fish															
Bovichthys variegatus	68											1	1	2	
Gnathanacanthus goetzii	23			2											
Heteroclinus johnstoni	73	1	1	4								2		1	
Norfolkia striaticeps	70								1						
Parascyllium variolatum	105								1	1					
Scorpaena ergastulorum	21		1		1	4								1	
Invertebrates															
Amblypneustes sp.	220				4										
Astrostole scabra	219			1											
Austrofromia polypora	208											1			
Cabestana tabulata	247		1								1		2		
Charonia rubicunda	246					1									
Chlamys asperimus	249				1										1
Comanthus trichoptera	200	1	569	116	43	14	17	2			16	13	8	1	4
Coscinasterias calamaria	209				1		1		1						
Goniocidaris tubaria	206		1				3		1						
Haliotis emma	252				3						6				
Haliotis laevigata	240				3	2	3	1			4				
Haliotis rubra	241	34	1	8	10	11	18	68	36	23	29	58	19	177	202
Heliocidaris erythrogramma	202	20	214	197	354	17	129	33	14	176	588	299	177	119	329
Holopneustes inflatus	204		1							7		1			
Jasus edwardsii	270			1			2	8					3		
Mayena australiasia	253										5	1			
Nectocarcinus tuberculatus	271			2				1			1	2		4	1
Nectria ocellata	210	1	5	1			1	4			1			1	
Nepanthia troughtoni	222							5							
Pagurid (grey)	274		3	1			2				3	3	17	13	17
Paguristes (red)	273						1					1			
Pateriella calcar	221								1						
Patiriella brevispina	211	1		4					10						
Penion mandarinus	244										1		2	1	
Pentagonaster duebeni	213		1		2							6		1	1
Petricia vernicina	212			1	1		2	2	2	1			1		1
Plagusia chabrus	272	7	4	8	2			1	4			6	3	2	1
Plectaster decanus	214	2	1	9	2		1				5	4	2		9
Pleuroploca australasia	242			2		1		1	1		1	2	9		5
Sepia apama	251						1								
Thais orbita	250	1	3	1	2	8	10	8				1	23	11	1
Tosia australis	216	2	6	13	2		16		2	2	6	27	12	2	10
Tosia magnifica	215			1											
Turbo undulatus	243	1		1		188	98	434	7				15	19	4
Uniophora granifera	217	1	1				1				5		3	1	3
Total invertebrate species:		11	14	17	14	8	17	13	11	5	15	15	15	13	15

Table 4. Species abundance per site for invertebrates encountered during the Waterhouse, King Island and Rocky Cape surveys.

Tasmanian North Coast and King Island Macroalgal Survey															
Location:		Waterhouse Point				King Island					Rocky Cape				
	site	1	2	3	4	1	2	3	4	5	1	2	3	4	5
Species	code														
Acrocarpia paniculata	300	46	80	57	26		16	12		26	19	37	40	30	7.1
Ballia callitricha	370		0.2			0.1			0.5			0.2			
Carpoglossum confluens	302	0.2	3.7	1.1						0.4	0.2	0.8	0.5	0.2	8
Caulerpa annulata	368														0.1
Caulerpa brownii	351	4.3					0.6	3.2	0.3	1.9	0.3		0.9		0.7
Caulerpa cactoides	352				1.3			0.6		2.6					0.7
Caulerpa flexilis	353	2.6	0.2		0.6						1.4	0.6	0.3		0.3
Caulerpa longifolia	355														0.3
Caulerpa obscura	366					0.5	7.5	2.8	1.2	6.1					
Caulerpa papillosa	356	0.1													
Caulerpa scalpelliformis	357	0.2					0.3								
Caulerpa simplisciuscula	358	0.1				0.1	0.1	0.1		0.2					
Caulerpa vesiculifera	360						0.3	1.7		4.2					
Caulocustis uvifera	304	1.7			2.5										
Caulocystis cephalornithos	303							2.8		1			0.2		
Codium pomoides	364							0.2		0.1					
Codium spp.	363					0.8		1.3			0.4				
Cystophora expansa	308				5.4										
Cystophora monilifera	309	2.9	2.8			1.2		1.3							0.4
Cystophora moniliformis	310	4.6	6.6	21.4	8.1	0.2	3.2	2.9	0.9	8.4		4.2	10	1.8	1.3
Cystophora platylobium	311					3.4			0.4			4.4	0.1	3	0.8
Cystophora retroflexa	314			1.9	15						4.7	1.8	5.6	2.4	20
Cystophora siliquosa	315						4.4	9	0.3	32					
Cystophora subfarcinata	316	2.5		3.6	2.1	0.8	2.6	11		1.5		0.2	1.9	0.9	
Dictyopteris muelleri	319				8.6		0.5								
Dictyospaeria serica	367									0.7	0.1				
Dictyota dichotoma	320	0.4								1.7					
Durvillaea potatorum	321								4.8						
Ecklonia radiata	322	0.2	0.1			16	12				0.5	16	4.8	43	30
Euptilota articulata	410					1.2									
Halopteris spp.	324	8.1	0.1	0.1			7.7	0.2				0.3	0.5	1	0.4
Heterozostera tasmanica	401					2.5									
Laurencia spp.	379					0.5			0.3						
Lessonia corrugata	327								0.4						
Macrocystis angustifolia	329						0.3						0.4		
Melanthalia obtusata	382											0.2			
Perithalia cordata	332	3.4	1.2	1.1	2.5		17	9.1	0.6	2.2	1.9	5.9	3.9	2.2	0.3
Phacellocarpus labillardieri	383	1.1	0.7	0.8			0.3	0.7		1	0.4			0.2	
Phyllospora comosa	333	5.6				54			80			19		13	1.6
Plocamium angustum	384	2.6	0.9	1.3					0.3			0.1			
Plocamium cartilagineum	385						0.4	0.1	0.2						
Plocamium dilatatum	387	0.3					0.8								
Plocamium mertensii	389		1				0.4					0.3			
Plocamium potagiatum	390	0.3													
Pterocladia spp.	396			3.2											
Sargassum decipiens	347						1.9	1			3.2	0.6	6.9	0.8	16
Sargassum fallax	334				1.1										
Sargassum heteromorphum	500	0.4			0.4						0.3				
Sargassum lacerifolium	501		1.1			6.4									
Sargassum sonderi	350		3		1.5										
Sargassum spp.	344	5.9	0.3	1.9			0.6		0.3		1.4	2.8	0.9	1.8	1.6
Sargassum varians	349	8.2	0.7	4.6	10						2.9	1.7	0.5		5.8
Sargassum verruculosum	336				1.1	0.5	0.7	9.1					0.2		1.6
Seirococcus axillaris	338	6.1	30	36	14	17	0.9	0.4	6.6	0.3	0.2				
Sonderopelta coriacea	391						0.8				1.4	0.3			0.2
Xiphophora chondrophylla	340				4.3		2.7	15	0.5	0.6					
Zonaria angustata	342			1.5							1.3			1.4	
Zonaria turneriana	343	2	1.4	1	11	0.5	6.8	0.7		1.4	6.4	7.3	5.3		4.4
Other thallous red alga	399	0.4	1.4			5	1.4	0.2	0.8	8.7	0.1				
Filamentous red algae	400	0.5					3.4	0.7	0.1					0.3	
Corallines	398	5.2	1.8	1.1	7.7		8	6.3	3.2	12	0.1	0.1	4.2	0.3	
Total number of species:		26	19	16	19	17	26	23	17	20	19	21	19	15	21

Table 5. Percentage cover of plant species per site estimated during surveys at Waterhouse, King Island and Rocky Cape.

Survey 2. King Island.

King Island is situated in the western approach to Bass Strait. It is a large island approximately 60km long and 20km wide. Due to its isolation, little was known of its marine biota and range of habitats and this led Edgar (1984) to suggest that a survey of King Island should be a high priority in any further review of the Tasmanian coastal biota. Most of the coastal reef around King Island is composed of Precambrian granite, with the exception of an outcrop of metamorphic rock in the vicinity of Currie on the west coast and at Surprise Bay in the south. An extensive sandstone reef exists offshore from Blowhole Creek on the eastern coast of King Island and extends north to Councillor Island. Six sites were surveyed around the coast of King Island (Fig. 2) and they were chosen in an attempt to cover as much of the coastline and as many habitats as possible.

Fish: The pooled results of the fish survey are presented in table 3. A total of 27 species of fish were encountered during the fish transects while a further 2 cryptic species were detected during the invertebrate transects (Table 4). The number of species encountered at each site ranged from 2 to 18, values which fell well below those encountered at the remaining locations surveyed in the Bass Strait region. The New Year Island site (site 3, Fig. 2) was the notable exception, and with a total of 18 species, this site was close to the average of the remaining Bass Strait survey sites. *Notolabrus tetricus* was abundant and the only species encountered at all sites, while *Notolabrus fucicola, Pictilabrus laticlavius, Parma victoriae, Cheilodactylus nigripes, Scorpis aequipinnis, Dinolestes lewini,* and *Neoodax beddomei* were locally abundant. Out of a total of 29 species encountered during the survey, 19 were species widely distributed throughout Tasmanian waters while 10 were species restricted in their Tasmanian distribution to Bass Strait. These included *Melambaphes zebra, Scorpis aequipinnis, Enoplosus armatus* and *Meuschenia hippocrepis,* known to be distributed throughout southern Australia; *Girella elevata,* a species with Peronian affinities; and *Heterodontus portusjacksoni, Parascyllium variolatum* and *Parma victoriae,* species with Flindersian affinities. *Parascyllium variolatum* is only recorded from King Island in Tasmanian waters (Hutchinson and Swainston, 1986). Only two of the species encountered, *Girella elevata* and *Parascyllium variolatum,* are not common in Tasmanian waters, indicating that the fish communities of King Island may differ little from those found in similar habitats on the Tasmanian north coast.

Invertebrates. Five invertebrate transects were conducted during the survey (sites 1-5, Fig. 2) during which a total of 25 species of megafaunal invertebrate species were encountered (table 4). The number of species detected per site ranged from 5 to 17, with the lower values being associated with sites of little structural complexity. *Heliocidaris erythrogramma* and *Haliotis rubra* were common and present at all sites while *Comanthus trichoptera, Turbo undulatus, Thais orbita* and *Tosia australis* were locally abundant. Only 4 of the 25 species encountered are restricted in their Tasmanian distribution to the north coast. The remaining species are commonly found throughout

Tasmanian waters. *Haliotis laevigata* and *Nepanthia troughtoni* have a northern distribution with Flindersian affinities, while *Patiriella brevispinna* and *Plectaster decanus* have a more general northern distribution. *Nepanthia troughtoni* was the only species not encountered during the other Bass Strait surveys or commonly found in Tasmanian waters. This indicates that the King Island invertebrate communities may not differ significantly from those found at similar habitats on the northern Tasmanian coastline.

Macroalgae. Five sites were surveyed for diversity and percentage cover of macroalgae around King Island (Fig. 2), during which a total of 43 species were encountered (table 5). *Caulerpa obscura, Seirococcus axillaris,* and *Cystophora moniliformis* were the only species in common with all sites and their abundance varied greatly between sites. This is a reflection of the range of habitats encountered at the five sites. This range included site 4 (Surprise Bay), a site of moderate to high exposure, typified by an algal assemblage dominated by *Phyllosphora comosa, Durvillaea potatorum* and *Seirococcus axillaris,* through to site 3 on the north side of New Years Island, a site of only slight exposure, with an algal assemblage dominated by *Acrocarpia* and various species of *Cystophora* and *Sargassum.* Of the 43 species of macroalgae encountered during the King Is survey 39 were species with a widespread Tasmanian distribution, while the remaining 4 species were those whose Tasmanian distribution was limited to Bass Strait. These included *Cystophora monilifera,* a species with a widespread southern Australian distribution; and *Cystophora siliquosa, Caulerpa vesiculifera,* and *Xiphophora chondrophylla,* species with a more Flindersian distribution. All of the macroalgal species encountered were typically found on the northern Tasmanian coast as well. The most notable species recorded during the survey was *Lessonia corrugata,* a species normally restricted to more southern Tasmanian waters.

Habitats: The King Island macroalgal data indicates that a wide range of habitats are found around the island. The western and southern coasts are exposed to the prevailing winds and swells and are characterised by the presence of the macroalgae *Durvilleae potatorum* which extends from the sub-littoral fringe down to approximately 5m. This species is harvested commercially on King Island. The eastern coastline appears to be characterised by habitats of moderate exposure, with macroalgal assemblages characterised by *Phyllosphora comosa* as the dominant species, interspersed with species of *Sargassum* and *Cystophora.* There are few bays or headlands along the King Island coastline to offer more sheltered habitats. The only sheltered area detected during this survey occurred on the northern and eastern shores of the New Years Islands, and in the passage between these islands and Whistler Point on King Island. Site 3 of this survey was on the northern shore of New Year Island and was characterised by a macroalgal assemblage at 5m of *Acrocarpia, paniculata, Cystophora subfarcinata, C. siliquosa, Sargassum verruculosum, Perithalia caudata* and *Xiphophora chondrophylla,* an assemblage typical of a moderately sheltered habitat. An investigation of the eastern coasts of the New Years Islands revealed extensive seagrass beds dominated by *Posidonia sp.* and these were the only seagrass beds found during this survey. The

presence of the seagrass indicates that this area must be well protected from the prevailing wind and swells which determine the biotic assemblages on most of King Island's western coastline.

Summary of King Island survey.

1. The reef habitats of King Island appear to be those of predominantly moderate exposure along the eastern coastline and moderate to heavy exposure along the western coastline. The passage between the New Years Islands and Whistler point on King Island is one of the few areas offering more sheltered habitat, and was the only site where seagrass was found. While this survey was restricted to the biota at 5m depth, it was apparent that many areas of reef on the western coastline extended to depths of 20m or more, providing a range of habitats not present along most of the Tasmanian north coast which is relatively shallow.
2. The biota found during the survey had a component of species not generally found south of Bass Strait and not presently represented in the existing Tasmanian marine reserves. These included 5 macroalgal species, 4 megafaunal invertebrate species and 10 fish species.
3. The biota encountered during the survey was generally similar to that found at similar habitats on the Tasmanian north coast. The only notable difference being the unusually low diversity of fish species.
4. Of the species whose distribution was restricted to northern Tasmanian waters, 9 were of widespread distribution in southern Australia, 8 were of typically Flindersian distribution, and 1 was of Peronian distribution, indicating that the biota of King Island is influenced predominantly by Maugean and Flindersian components.
5. The waters surrounding the New Years Islands appear to be the most appropriate area to situate a marine reserve. They encompass a wide range of habitats including deep and shallow reef, exposed reef, sheltered reef, and seagrass, all within close proximity. Of the sites investigated during this survey, New Year Island had the greatest fish diversity, a factor related to the diversity of habitats nearby and the complex physical structure of this area.

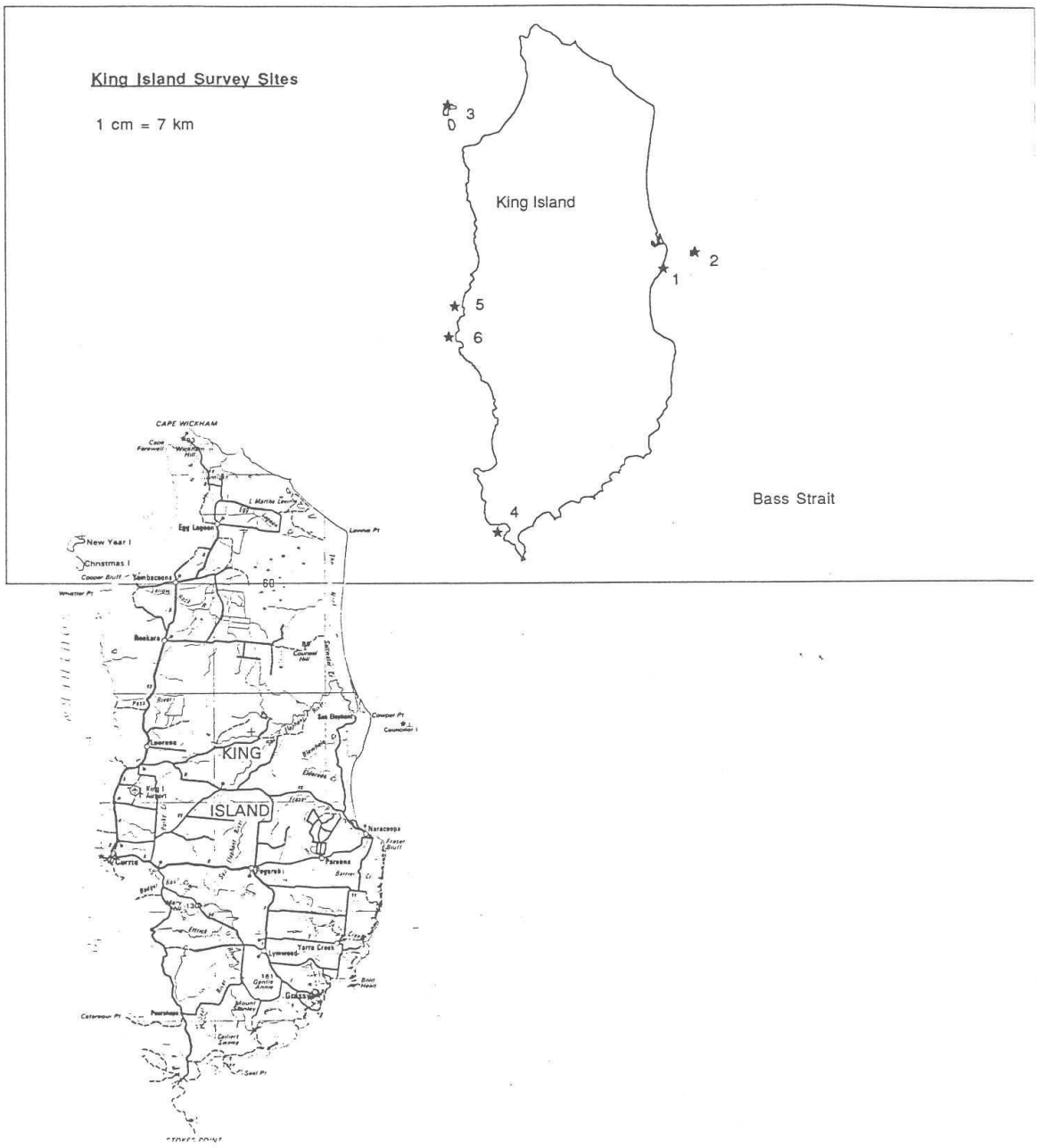


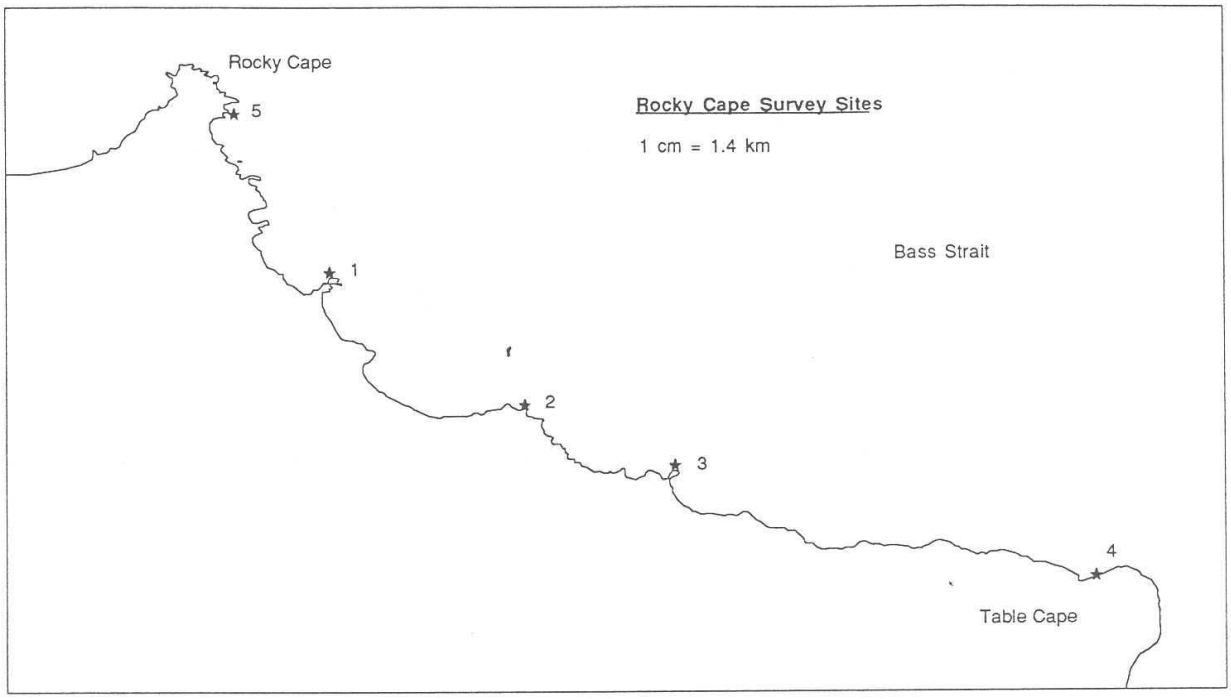
Figure 2. Map of King Island and location map for sites surveyed.

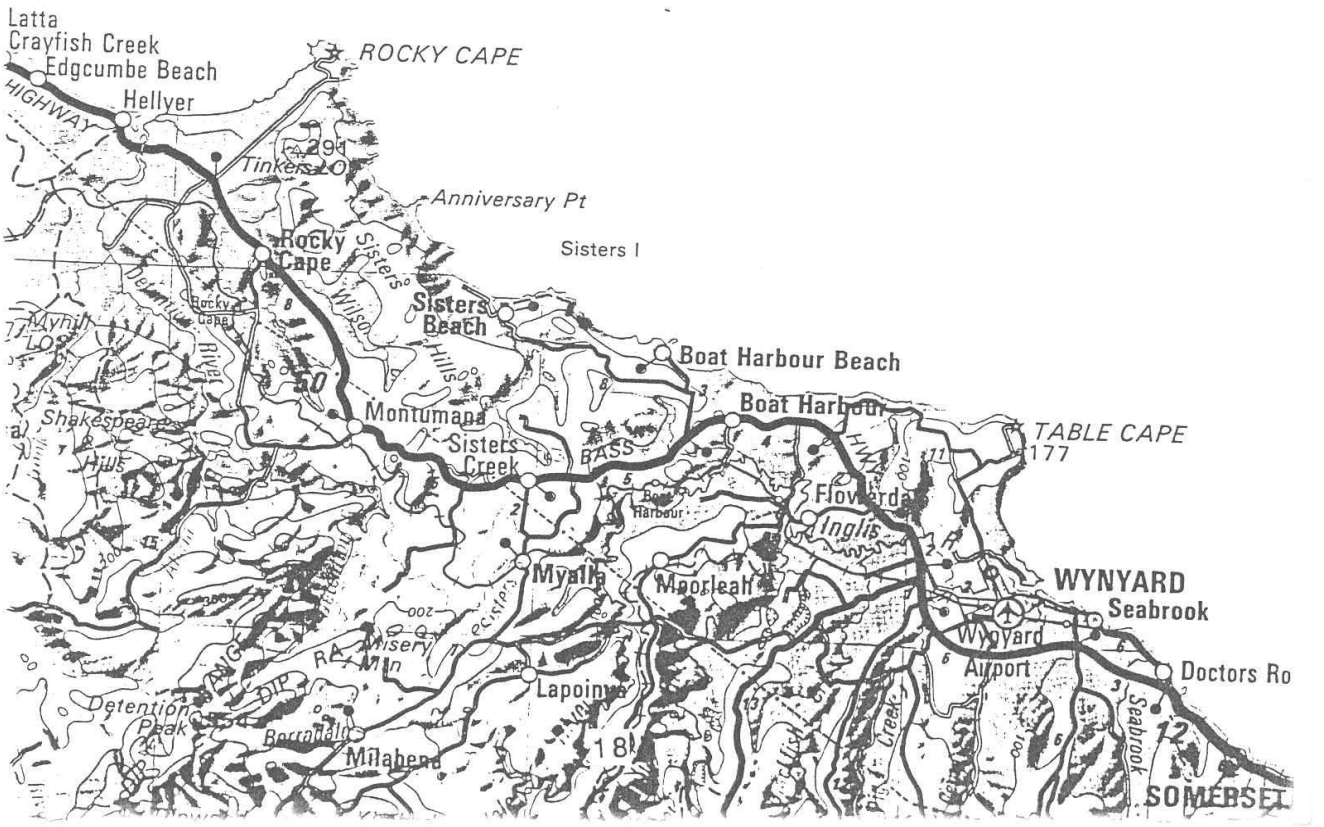
Survey 3. Rocky Cape.

The section of coastline from Rocky Cape to Table Cape is the natural choice of any survey of the reef areas of Tasmania's north and north west coast, as the remaining areas of coastline are either long stretches of sand or shallow reef, much of which is heavily polluted. Rocky Cape was the focus of an earlier survey of potential marine reserve sites by Edgar (1981) who recommended that "a marine reserve extending to a distance of 1km from the shoreline should be declared from Boat Harbour Beach to West Rocky Cape Beach off Rocky Cape National Park." This section of coastline is a popular destination for shack owners, campers and tourists, encompassing coastal population centres at Rocky Cape, Sisters Beach and Jacobs Boat Harbour, with the large regional town of Wynyard nearby. There is shoreline access at Rocky Cape, Jacobs Boat Harbour, and Sisters beach, and boat ramps are situated at Sisters Beach and Rocky Cape. The coastal geology of this area is dominated by two rock types, the distinctive Precambrian metamorphic quartzites of the Rocky Cape National Park and the Tertiary basalts comprising the Table Cape massif and extending along the coastline towards Sisters Beach.

Fish: Five sites were surveyed for fish diversity and abundance in the Rocky Cape survey. The survey sites are shown in Fig. 3 and pooled results are in table 3. A total of 36 species of fish were encountered during the fish census while another 4 cryptic species were detected during the invertebrate transects (table 4). The number of species encountered at each site during the fish transects ranged from 18 to 26 and with the exception of the high count of 26 at Table Cape, were similar to the range encountered during the Waterhouse survey. *Notolabrus tetricus* and *Trachinops caudimaculatus* were abundant at all sites while *Notolabrus fucicola, Pictilabrus laticlavius, Neoodax beddomei, Meuschenia australis, Cheilodactylus nigripes,* and *Caesioperca rasor* were present at all sites but only locally abundant. This variation being due to the differences in habitat between the 5 sites. *Pempheris mutitradiatus* was a major component of the fish community at a number of sites due to the availability of cave structures which this species prefers. Of the 40 species encountered during the fish and invertebrate transects, 7 were species whose Tasmanian distribution is restricted predominantly to the north coast. These included *Melambaphes zebra, Scorpis aequipinnis, Enoplosus armatus, Cheilodactylus nigripes* and *Hypoplectrodes nigrorugrum,* species with a widespread distribution in southern Australia; and *Meuschenia hippocrepis* and *Parma victoriae,* species with an essentially Flindersian distribution. *Hypoplectrodes nigrorugrum* was the only species encountered during this survey which is not commonly found in Tasmanian waters. This species was also recorded from Rocky Cape during the survey of Edgar (1981).

Figure 3. Map of Rocky Cape region and location of sites surveyed.





Invertebrates. Five sites were surveyed for megafaunal invertebrate abundance in the Rocky Cape region (Fig. 3). A total of 24 species were encountered during the survey (table 4) with a range of 13 to 15 species per site, which appears typical of that found throughout the north coast. The megafaunal community was dominated at all sites by *Heliocidaris erythrogramma* and *Haliotis rubra* , while *Comanthus trichoptera, Tosia australis* and the grey hermit crab *Paguris sp.* were present at all sites and locally abundant. *Thais orbita* and *Turbo undulata* were also locally abundant. Of the 24 species encountered during the survey, 21 were of widespread Tasmanian distribution while only 3 were species with their Tasmanian distribution restricted to the north coast. These were the abalone *Haliotis emma (= scalaris)* and *Haliotis laevigata,* species with a Flindersian distribution, and *Plecaster decanus,* a species with a more widespread distribution. The abundance of *Heliocidaris erythrogramma* at all sites indicates that, at least at 5m depth, all sites were of low to moderate exposure only.

Macroalgae: Five sites were surveyed for macroalgal diversity and percentage cover (fig 3). A total of 37 species were identified in the overall survey while the total for each site ranged between 15 and 21 (table 5). *Acrocarpia paniculata, Ecklonia radiata, Cystophora retroflexa* and *Sargassum decipiens* were present at all sites surveyed and locally abundant, while *Carpoglossum confluens* was also found at all sites. *Phyllosphora comosa* was locally abundant. At most of the sites surveyed there was a heterogeneous mixture of algal species including those typical of shallow water eg *Cystophora retroflexa* and those typical of more exposed water eg *Phyllosphora comosa.* This appears to reflect the complex physical structure of the underwater topography, which allows a variety of habitats to occur in a small area. Of the 37 species found during the survey, only two were species whose Tasmanian distribution was restricted to the north coast. These were *Cystophora monilifera,* a species widely distributed in southern Australia; and *Sargassum heteromorphum,* a species with a more Flindersian distribution.

Habitats: The Rocky Cape region offers a wide range of habitats within a small section of coastline. The western side of Rocky Cape is very shallow with seagrass beds, while reefs north of Rocky Cape reach depths in excess of 20m (Edgar, 1981). While this section of coastline is moderately exposed, an abundance of small bays and headlands provide relief from prevailing winds and swells, thus offering some areas of more sheltered habitat. The rocky reefs of this region are structurally very complex with many caves and large block features and this structural complexity appears to enhance the variety of habitats available within the area.

Summary of Rocky Cape Survey.

1. The Rocky cape region encompasses a diversity of reef habitats within a small area. These include deep and shallow reef, sheltered and exposed reef. On the western side of Rocky Cape, areas of reef exist with adjacent seagrass beds.

2. Much of the coastal reef is structurally complex with many caves and large block features adding to the range of habitats available. This contrasts with many of the remaining north coast reefs of Tertiary basalt and Jurassic dolerite which are usually featureless.

3. The biota found during the survey had a moderate component of species not generally found south of Bass Strait. These included 7 species of fish, 3 species of megafaunal invertebrates, and 2 species of algae. Of the northern species, 8 have a widespread southern Australian distribution while the remaining 4 have stronger Flindersian affinities.

4. The entire section of coast from Rocky Cape to Jacobs Boat Harbour contains areas eminently suitable for a marine reserve, and no one section was identified as having a higher conservation value than any other. A similar observation may have led Edgar (1981) to suggest this entire section of coastline be declared a marine reserve. While site 4 (Table Cape) of this survey was also structurally complex, and had the highest fish diversity of any site, the area immediately surrounding this site appeared to lack any significant reef development, thus limiting the value of any reserve at Table Cape.

Survey 4. Eastern Bass Strait Islands

In an earlier survey of potential marine reserve locations in this region Edgar (1984) surveyed the waters of southern Flinders Island and the Kent Group of islands. He identified the Kent group as having outstanding biological values, and recommended that a reserve be declared to cover all waters within 2km of Erith, Dover, Deal and North East islands. This recommendation was not acted upon and the Kent group remains unreserved.

To complete the survey of potential marine reserve sites in the Bass Strait region, the Tasmanian islands lying between Flinders Island in Tasmania's north east and Wilsons Promontory, Victoria were investigated (Fig. 4) These included Curtis Island, the Hogan Group, and the Kent Group of islands. An opportunistic survey of Cape Barren Island (lying to the south of Flinders Is.) was also undertaken.

Cape Barren Island.

Cape Barren Island is a large, populated island situated south of Flinders Is. (Fig. 5). The survey of this island was brief and restricted to 2 sites, Slopin Point, and Passage Point, both on the islands south coast. Passage point is a moderately exposed site, which lies at the eastern entrance to Armstrong Channel, an area of very strong tidal flows and large standing waves. This site was unusual in that the area of reef below 5m depth was exposed to very strong currents, and as a consequence, the megafaunal invertebrate community was dominated by the filter feeder *Comanthus trichoptera*, which formed a mat covering most of the bottom. Slopin Point is also in Armstrong Channel, however it is a sheltered site and is removed from strong tidal currents.

Fish: Eighteen species of fish were identified during the transects at Cape Barren Island (table 6), with the total species per site being 10 and 12, low values when compared with other north coast sites. There was little overlap of species between sites probably due to differences in exposure and current regimes between sites. Of the 18 species encountered, 16 were species with a widespread Tasmanian distribution and 2 were species with their Tasmanian distribution limited to Bass Strait. These were *Parma victoriae,* a species with a Flindersian distribution and *Siphamia cephalotes*, a species with a widespread southern Australian distribution.

Invertebrates: A total of 22 species of megafaunal invertebrates were recorded during this survey (table 7), of these 17 had a widespread distribution, while 3 were restricted in their Tasmanian distribution to the north coast and Bass Strait. These

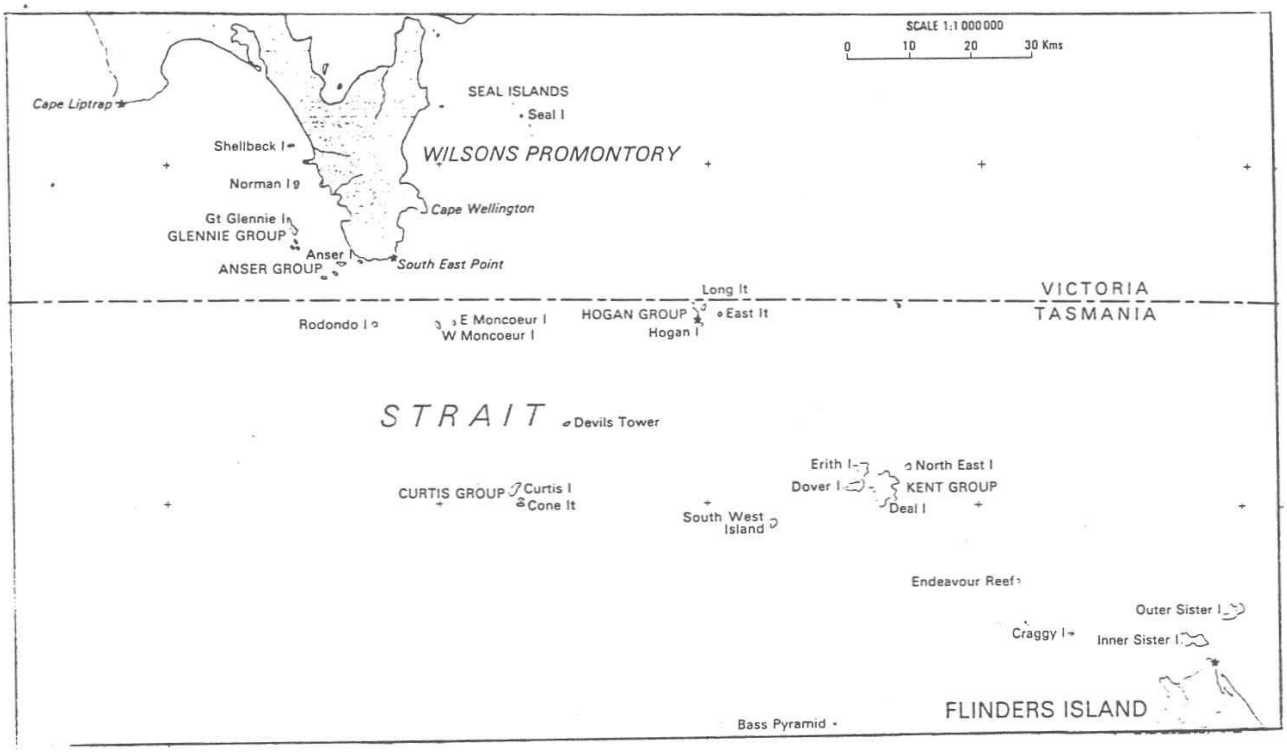


Figure 4. Tasmania's northeastern islands.

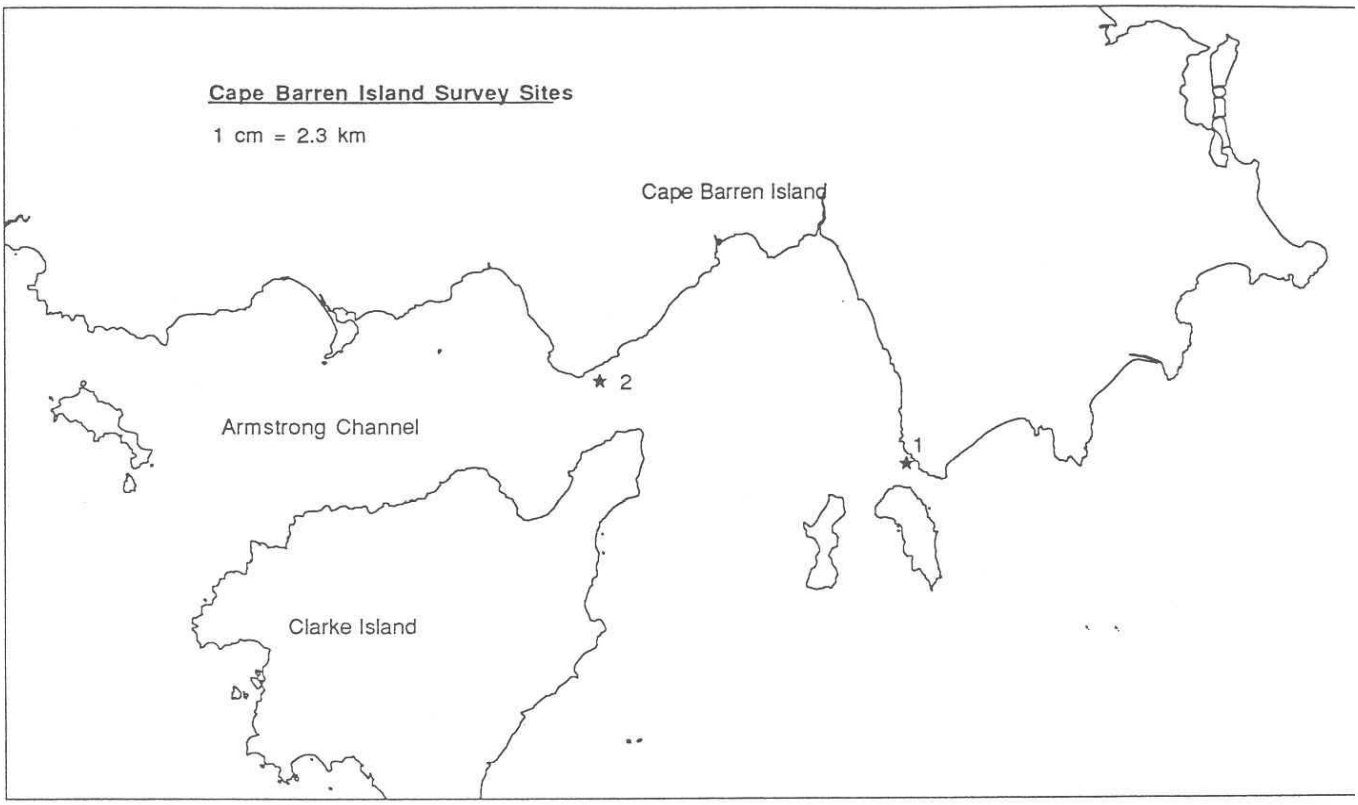


Figure 5. Location of sites surveyed at Cape Barren Island.

Eastern Bass Strait Fish Survey																					
Location:		Cape Barren Island		Curtis Island		Hogan Island				Kent Group											
	site	1	2	1	2	1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12
Species	code																				
Achoerodus gouldii	112			1																	
Apogon conspersus	29												1								
Atypichthys strigatus	42		5																	11	2
Bovichthys variegatus	68													2							
Caesioperca lepidoptera	24												170			36					13
Caesioperca rasor	25			58	55	18	77	20	11	46	210	80	734		3	1744	70	10	333	540	1139
Cephaloscyllium laticeps	3																	1	1		
Cheilodactylus nigripes	49			1	4	3	7	9	14	2	15	6	23	1	3	26	4	1	13	13	19
Cheilodactylus spectabilis	50			2	9	7		2	1	2		2	5		3	4	5	1		4	8
Chromis hypsilepis	45								1		82	32	55			64			2	57	3
Cyttus australis	16															1					
Dactylophora nigricans	51						1														
Dactylosargus arctidens	48	2		2	5	11			3		1		2		5		2	2	2	4	3
Dinolestes lewini	28																	3			
Diodon nichthemerus	98		1				1		10		1					1			2	2	1
Dotalabrus aurantiacus	56										2					2			2	5	
Ellerkeldia macculloch	26					2					8										
Enoplosus armatus	43				2	4	5	2	1	1		3	8			8	2	2	2	1	6
Eubalichthys gunnii	87						1				1		2			6					
Girella elevata	36															4	1	1			
Haletta semifasciata	65	4																			
Hypoplectrodes nigrorubrum	110															1					
Kyphosus sydneyanus	38															3					11
Latridopsis forsteri	53				2				4	2			1					1			
Latropiscis purpurissatus	7						1														
Lotella rhacinus	8											1									
Melambaphes zebra	39			1	4	7	4	3	1	2	8	4	5			16	1	3	4	1	20
Meuschenia australis	88										1					1					
Meuschenia flavolineata	89											1	1			3					
Meuschenia freycineti	90			1	5	6	5	5	7		3		3			6	4	3	1	9	1
Meuschenia hippocrepis	91												2			8			1		10
Meuschenia venusta	116															1					
Neoodax balteatus	63		9																	1	
Neoodax beddomei	64	6	10								1	7								19	
Notalabrus fucicola	58	6		72	185	78	5	56	13	12	12	20	46	80	52	48	33	35	12	41	32
Notalabrus tetricus	60	61	41	15	111	47	96	109	140	124	113	106	164	57	21	54	20	30	143	117	80
Odax acroptilus	61							1	1	2		2	3				2		2	3	4
Odax cyanomelas	66	3		27	24	81	1	49	6	6	14	25	11		3	7	7	16	11	25	10
Ophthalmolepis lineolatus	111											1									
Panka scaber	92										2	2	4			10					
Parma microlepis	46			1					3	1	13	4	12		1	24			1	5	5
Parma victoriae	47	2	7	1			6	2	1				2			4			4	2	1
Pempheris multiradiatus	35		7				1			1						2	3			30	6
Penicipelta vittiger	93	1		12	22	1			2		35	49	6			32	15	7	3	12	9
Pentaceropsis recurvirostris	44					1		1								1					
Pictilabrus laticlavius	57	8	7	1	1	3	4	3	6	2	8	4	8			5	1		5	4	4
Pseudolabrus psittaculus	59			3						1	2	1	8		1	3				1	
Sardinops neopilchardus	114		570																		
Scorpis aequipinnis	40			12	32	13	21		12	1	6		17		4	29		5	2	15	35
Scorpis lineolatus	41								7							5					
Sepia apama	251											1									
Siphamia cephalotes	115		2																		
Siphognathus sp.	113	1																			
Siphonognathus attenuatus	62	2																			
Trachinops caudimaculatus	27			2							36	14	23			31			74	38	25
Upeneichthys vlamingii	34	3					6			1	6	15	2			5	1	1		33	3
Total number of species:		12	10	17	14	15	17	13	20	16	23	22	27	4	10	34	16	17	21	26	25
Diversity index (H)		2.2	0.9	2.7	2.5	2.8	2.5	2.4	2.6	1.9	3.2	3.2	3.2	1.1	2.1	4.2	2.7	3	2.4	3.7	3.8

Table 6. Species abundance per site for fish and cephalopods encountered during the survey of the eastern Bass Strait islands.

Eastern Bass Strait Invertebrates Survey																					
Location:		Cape Barren Island		Curtis Island		Hogan Island				Kent Group											
	site	1	2	1	2	1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12
Species:	code:																				
Cryptic fish																					
Apogon conspersus	29											3							1		
Bovichthys variegatus	68														1						
Cephaloscyllium laticeps	3																1				
Heteroclinus forsteri	72							1													
Heteroclinus johnstoni	73																			2	
Norfolkia striaticeps	70			2				1			5		2								
Invertebrates																					
Amblypneustes grandis	205										3										
Amblypneustes sp.	220		3				1				1										1
Austrofromia polypora	208										1	1			5	1	3				
Cabestana waterhousi	254	15																			
Centrostephanus rodgersii	203	1		3			22	2	1	7	68	26	174		3	398	9		28	42	43
Comanthus tasmaniae	201	1																	3	2	
Comanthus trichoptera	200	94	133				1	1	1	6	15	7	19			1	3	3	14	41	6
Echinaster arcystatus	223			1																	
Goniocidaris tubaria	206		5																		
Haliotis emma	252			1																	
Haliotis laevigata	240	11	47					19		3				1							
Haliotis rubra	241	21	18	326	28	244		40	32	27	9	6	3	98	84	2	72	82	6	1	2
Heliocidaris erythrogramma	202	179	185	23	11	57	606	304	129	142	619	217	566	48	32	121	123	29	169	425	326
Holopneustes inflatus	204									2					1						
Holopneustes porossimus	225													1							
Jasus edwardsii	270		1			1				1	2	1	1								
Nectocarcinus tuberculatus	271					1	2	1		1	1	2					2				1
Nectria macrobranchia	224				1				1				1								
Nectria ocellata	210	2	1	1				2	1	6	1	3	1	3	3	2		5	3	1	5
Pagurid (grey)	274						1	1			1										
Paguristes (red)	273	2																			
Paranepanthia grandis	226	1																			
Patiriella brevispina	211	139	6																		
Pentagonaster duebeni	213		5								2	1	2		1	1				1	1
Petricia vernicina	212		1	2			1		1	3	2	6	6		1	1		1		3	3
Plagusia chabrus	272			6	3	14	2	6	4	2	8	4	6	2	5	1	11	8	1	4	7
Plectaster decanus	214	1	1	1	2							1	1		1	2	1		2	1	
Sassia sp.	255		1																		
Thais orbita	250	1		2	3	5		1						3	7		7	4			1
Tosia australis	216	9	4	2		1						1		1	2						
Turbo undulatus	243		1											1				1			2
Uniophora granifera	217		10																		
Total invertebrate species:		14	16	11	6	7	8	10	8	11	14	13	11	9	12	10	9	7	8	10	12

Table 7. Species abundance per site for invertebrates encountered during the eastern Bass Strait islands survey.

Eastern Bass Strait Macroalgal Survey																					
Location:		Cape Barren Island		Curtis Island		Hogan Island				Kent Group											
	site	1	2	1	2	1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12
Species	code																				
Atyphnia sp.	521						0.2		0.4			0.2									
Acrocarpia paniculata	300	0.8				7.7	1.5	0.5	5	8.3	15	3.4	9.9	0.5		0.4		5.8	9.4	5.9	26
Ballia callitricha	370				0.8	1.1		0.8		0.4		0.2		0.4	3.6			0.7	0.6	0.1	
Callophyllis rangeriifennus	371																				
Carpomitra costata	345													0.1					0.3		
Caulerpa brownii	351				9	3.6	8.6	5.3	9.7	3.6	1.2	7		6.2	2.1				1.2		3.4
Caulerpa cactoides	352		6																		
Caulerpa flexilis	353	12	3.8				3.6		30	0.2	1.7	3.9							3.6		
Caulerpa flexilis var. hypnoides	369						0.2												1.4		
Caulerpa longifolia	355		6.1																		
Caulerpa obscura	366		1.3				20		9.8												
Caulerpa simplisciuscula	358	0.2																			
Caulerpa vesiculifera	360						1.3		1.4		0.5								1.5		
Caulocustis uvifera	304						6.3														
Caulocystis cephalomithos	303									0.4											
Codium dimorphum	522																				
Codium fragile	362	0.7	2.3																		
Codium pomoides	364		0.1				1.1	0.1													
Codium spp.	363	0.2																			
Cystophora congesta	504							3.2													
Cystophora monilifera	309	2.2					1.5		1	11	1.9	2.6	3.4						6	6.4	1.8
Cystophora moniliformis	310	3.2	1.2		1.3	0.5	12	4.3	2.7	13	8.2	16	17		0.8		2	7.7	3.8	4.1	1.7
Cystophora platylobium	311	0.7		0.9																	
Cystophora retroflexa	314	0.5	6																		
Cystophora subfarcinata	316						0.4		3			2.4		0.3	0.3				1.4		0.4
Cystophora xiphocarpa	318																				
Delisea pulchra	373			0.2		0.2	0.1										0.1				
Dictyopteris muelleri	319	0.3	0.2																		
Dictyota dichotoma	320		0.7																		
Durvillaea potatorum	321																				
Ecklonia radiata	322	11	31	37.9	30	0.7	8.5	46	27	24	31	32	39	1.4	47	0.7	59	2.9	55.4	51	51.5
Euptilota articulata	410		0.1																0.1		
Gelidium australe	511																				
Gelidium glandulaelolium	512																				
Halopteris spp.	324	0.1								0.2	0.5		3.4	0.1	0.1	0.1				1	1.1
Heterozostera tasmanica	401	1																			
Homeostrichus sp.	328		0.2																0.9		0.3
Laurencia spp.	379					3		0.1				0.6							0.8		
Lessonia corrugata	327																				
Macrocystis angustifolia	329													29	12						
Melanthalia obtusata	382				1.7	6.4	0.8	1.3	1.1	1.2	0.2			3.4	3.8		0.1		2.2	0.3	4.5
Penthalia cordata	332					5.9	8.1	8.9	4.5	2.4		1.6	1.3	1.2	1.3						
Phacellocarpus labillardieri	383		0.3	5.7	1.1	4.7	4.3	9.6	5.3	3.5		6.5	0.3	0.2	1.9		0.3	3	20	2.3	5.8
Phyllospora comosa	333	21		65.1	30	64		4.5		10	17	4.8	15			3.7	47	76		8.1	
Plocamium angustum	384	0.5		1.1		5	0.3	2.6	0.3	0.4	0.6	0.4		0.3	2.3			0.6	0.6	0.1	1.3
Plocamium cartilagineum	385	0.9			0.5	0.1		3				0.5		1.1	0.4	0.1			0.1	0.1	0.1
Plocamium dilatatum	387					6.8		0.5		0.3									0.5		
Plocamium leptophyllum	388	0.1		0.1																	
Plocamium mertensii	389					2	0.2	3.4	0.6						0.1				0.2		
Plocamium potagiatum	390			0.2		0.3					0.2								0.9		
Plocamium pressiaum	412	0.3																	0.2		
Posidonia australis	450																			1.5	
Pterocladia spp.	396				34	2.7		1.3			1.9	4.8	5.4	8.9	5.5				4	17	5.1
Sargassum decipiens	347	5	22				2.6				1.1	0.3	0.8								
Sargassum fallax	334		8.1																		
Sargassum heteromorphum	500		0.3				22					1.2								0.5	
Sargassum lacerifolium	501																				
Sargassum spp.	344								0.1			1.2				0.1				1.5	0.9
Sargassum verruculosum	336		2.3				1.3		9.5	16	2.3	5	0.7						0.3	0.5	0.2
Sargassum vestitum	335												10	0.1							
Scabena agardhii	337		0.5																		
Seirococcus axillaris	338	31	1.1							0.4					1.3						2.9
Sonderopelta coriacea	391	0.7							0.1	0.5	0.6					0.1			2		0.5
Sporochnus spp.	340		0.8				3.4	1.8	9.1	37	8.8	14	2.5	1.8	3.1	4.6			8.7	11	6.4
Ulva spp.	365																				
Xiphophora gladiata	341																				
Zonaria angustata	342	0.4																			
Zonaria turneriana	343	1.2	3.6	1.6	0.5	0.5	0.9	1.1	0.3	0.7	0.3	0.1		0.7	0.1	0.1		0.2	0.9	0.4	
Other thallous red alga	399	4.6	0.6	5.8	1.3	5.2	2.6	2.5	1.3	1.9	1	2	0.5	4.5	4.2	0.2	0.1	3	1.2	5.3	1.9
Corallines	398						1.5	0.5						4.5	1.8			0.5			
Total number of species:		23	22	9	10	18	24	19	20	20	18	22	13	17	17	9	6	8	27	18	18

Table 8. Percentage cover of plant species per site estimated during the eastern Bass Strait islands survey.

included *Centrostephanus rodgersii,* a species with Peronian affinities; *Paranepanthia grandis, Patiriella brevispinna,* and *Plectaster decanus,* species with a widespread southern Australian distribution. *Heliocidaris erythrogramma, Comanthus trichoptera, Haliotis rubra, and Haliotis laevigata* were abundant and present at both sites.

Macroalgae: 37 species of macroalgae were encountered during the survey (table 8), of these 34 were of widespread Tasmanian distribution, while 3 were species restricted in their Tasmanian distribution to Bass Strait. They included *Scabaria agardhii* and *Cystophora monilifera,* species with a widespread distribution in southern Australia, and *Sargassum heteromorphum,* a species with Flindersian affinities.

The algal composition at each site reflected the exposure present. Site 1 (Passage Pt.) was a moderately exposed site dominated by *Seirococcus axillaris, Phyllosphora comosa, Ecklonia radiata* and *Caulerpa flexillis,* while site 2 (Slopin Pt.) was a sheltered site dominated by *Sargassum decipiens, Sargassum fallax, Seirococcus axillaris* and *Ecklonia radiata.*

Summary:

1. The reef areas of southern Cape Barren Island include areas of sheltered habitat with slight currents, and areas of moderate exposure, some with strong current flows. These high current zones provide a unique habitat dominated by filter feeding organisms.
2. The fish diversity of this area was low compared with most other sites surveyed in Bass Strait.
3. The majority of species encountered were either those typical of the Maugean marine province, or widespread southern Australian species, while 3 species were those with a typical Flindersian distribution, and one species with a Peronian distribution.

Curtis Island

Curtis Island is a small (approximately 6km in circumference) uninhabited island of granitic origin, situated 30 km to the west of the Kent Group (Fig 6). It is an isolated island whose shores descend rapidly to the sea floor at a depth of 40m. Two sites were surveyed at Curtis Island and these were restricted to the only locations where the reef did not immediately drop off into deep water. As a consequence of deep water and the lack of bays, headlands, or offshore islands, all locations around Curtis Island were of moderate to high exposure.

Fish: 19 species of fish were encountered during the two fish transects (table 6), while one cryptic species was found during the invertebrate transects (table 7). *Caesioperca*

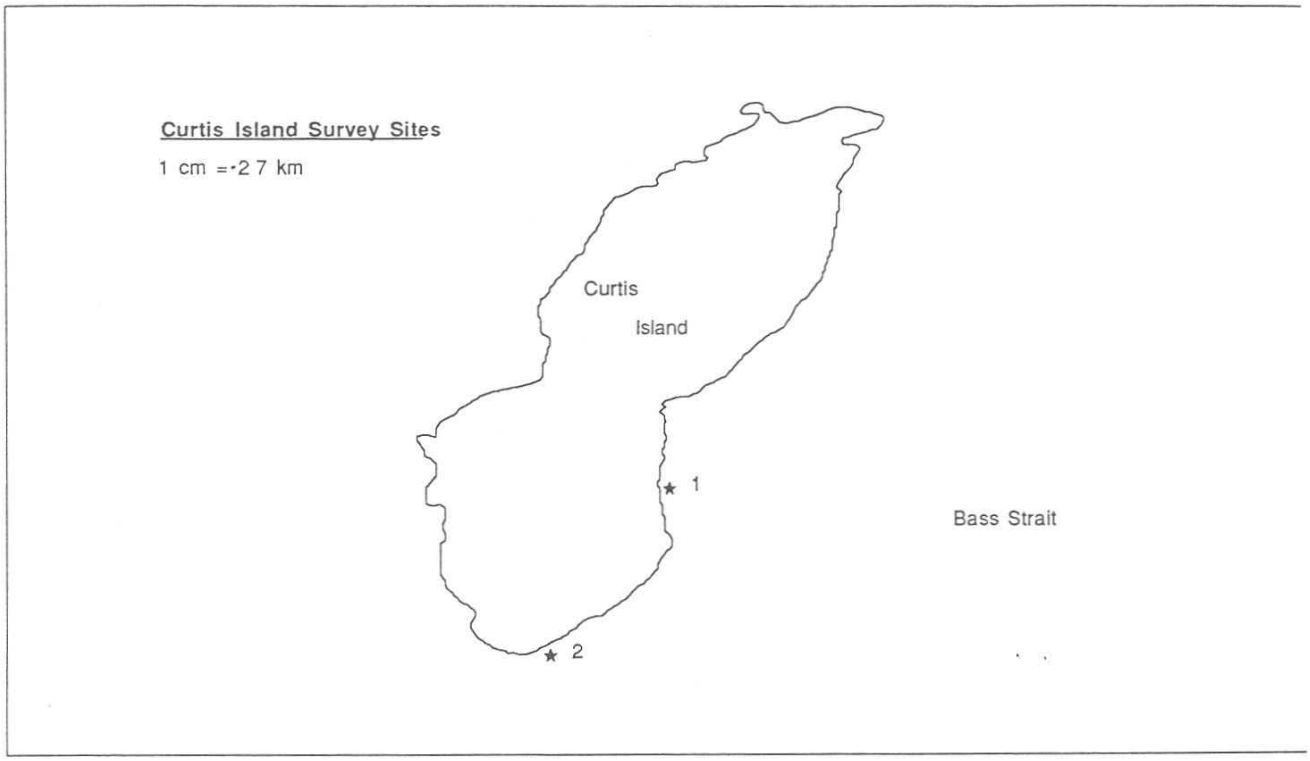


Figure 6. Location of sites surveyed at Curtis Island.

rasor, Notolabrus tetricus, Notolabrus fucicola, Odax cyanomelas, and *Penicipelta vittiger* were abundant and present at both sites. Of the 20 species encountered, 14 were species with a widespread Tasmanian distribution, while the remaining 6 were those restricted to Bass Strait in their Tasmanian distribution. They included *Melambaphes zebra, Scorpis aequipinnis, Enoplosus armatus, Cheilodactylus nigripes,* species with a widespread southern Australian distribution, and *Parma victoriae,* and *Achoerodus gouldii,* species with a typically Flindersian distribution.

Invertebrates: Only 13 species of invertebrates were encountered during the Curtis Island survey, probably due to the limited number of sites and habitats available. *Haliotis rubra* was the most abundant species, while *Heliocidaris erythrogramma* was also common. 4 species were invertebrates whose Tasmanian distribution was limited to Bass Strait were found and these included *Centrostephanus rodgersii,* a species with Peronian affinities; *Haliotis emma,* and *Nectria macrobranchia,* species with Flindersian affinities; and *Plectaster decanus,* a species with a more widespread southern Australian distribution.

Macroalgae: 15 species of macroalgae were identified at Curtis Island and all these were known to have a widespread distribution, with the exception of *Pterocladia sp.* (Table 8). The macroalgal community was typical of an exposed Bass Strait site with *Phyllosphora comosa* and *Ecklonia radiata* abundant at each site. The only notable observation at this survey was the high percentage cover of *Pterocladia sp.* at site 2.

Summary:

1. The shallow reef habitat around Curtis Island was limited, as most of the coastline drops rapidly to depths in excess of 40m. The diversity of habitats is low and is comprised of only shallow exposed reef or deep reef.
2. The biota with a northern Tasmania distribution were comprised of 5 species with a general southern Australian distribution, 4 species with Flindersian affinities and 1 species with Peronian affinities.
3. The limited number of habitats available at Curtis Island limits the suitability of this location as a marine reserve.

Hogan Group

The Hogan Group of islands are situated 30km to the south of Wilsons Promontory, Victoria. They are uninhabited, although Hogan Island has been cleared and is presently used for cattle grazing. The islands provide a safe anchorage in westerly to southerly weather, and a safe landing beach exists on the eastern side of Hogan Island. Most of the shallow reef area is restricted to an embayment on the north east coast of Hogan Island(sites 1 & 2, Fig. 7) as much of the remaining reef area consists of steep drop-offs immediately below the coastal cliffs.

Fish: A total of 27 species of fish were encountered during the 4 fish transects (table 6) while a further 2 cryptic species were encountered during the invertebrate transects (table 7). The number of species encountered per site ranged between 13 to 27, a range typical of that found during the Bass Strait survey. *Notolabrus tetricus, Notolabrus fucicola, Odax cyanomelas* and *Caesioperca rasor* were present and abundant at all sites. *Melambaphes zebra, Enoplosus armatus, Pictilabrus laticlavius, Cheilodactylus nigripes* and *Meuschenia freycinetti* were present at all sites, while *Scorpis aequipinnis* was locally abundant. Of the 29 species encountered, 18 were species with a widespread distribution in Tasmanian waters, while 11 species were those whose Tasmanian distribution was limited to Bass Strait. These included *Latropiscis purpurissatus, Odax acroptilis, Cheilodactylus nigripes, Dactylophora nigricans, Enoplosus armatus, Scorpis aequipinnis,* and *Melambaphes zebra,* species found throughout southern Australia; *Ellerkeldia maccullochi, Chromis hypsilepis,* and *Parma microlepis,* species with a Peronian distribution; and *Parma victoriae,* a species with a Flindersian distribution. The two notable features of the fish found at Hogan Island were, (1) an increasing presence of Peronian species compared with the previously discussed sites, and (2) the presence of *Dactylophora nigricans,* the dusky morwong. This was the only record of *D. nigricans* during the entire north coast survey, even though many of the survey sited included this species preferred habitat of reef adjacent to seagrass beds. This species, once common in northern Tasmania is now rare due to its susceptibility to gillnet entanglement (Last *et al.*, 1983).

Invertebrates: Four sites were surveyed for megafaunal abundance in the Hogan Group (Fig. 6). A total of 15 species were found during the survey with a range of 7 to 10 per site (Table 7). The most abundant species were *Heliocidaris erythrogramma,*
present at all sites and *Haliotis rubra,* which was locally abundant. Other significant species
included *Plectaster decanus, Heliocidaris laevigata* and *Centrostephanus*

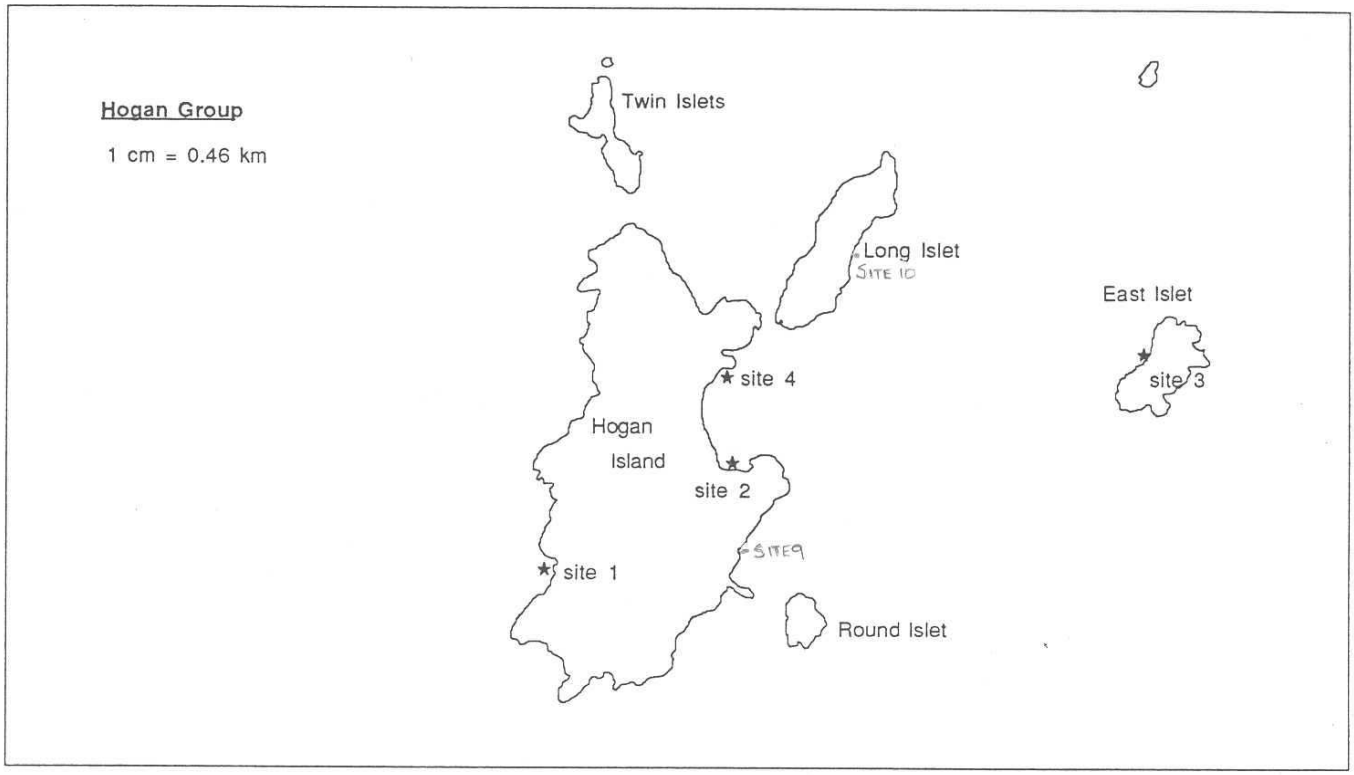


Figure 7. Location of sites surveyed within the Hogan Group of islands.

rodgersii. Of the 15 species encountered, 12 were species with a widespread Tasmanian distribution, while 3 were species limited to Bass Strait and southern Australia. These included *Haliotis laevigata* and *Nectria macrobranchia,* species with a Flindersian distribution, and *Centrostephanus rodgersii,* a species with a Peronian Distribution. *C. rodgersii* was moderately abundant, indicating an increasing Peronian influence.

Macroalgae: 34 species of macroalgae were identified during the Hogan Group survey, with a range of 18 to 24 species per site (table 8). The macroalgal community varied substantially between sites due to the variety of habitats covered by the survey. These ranged from site 1 (Fig. 6), an area of moderate to high exposure characterised by a macroalgal assemblage dominated by *Phyllosphora comosa* and *Acrocarpia paniculata,* through to site 2, a sheltered embayment with an algal assemblage dominated by *Sargassum heteromorphum, Cystophora moniliformis, Caulerpa obscura, Ecklonia radiata* and *Perithalia caudata.* While most of the species encountered were those with a widespread Tasmanian distribution, 3 species with a restricted northern distribution were found. These included *Caulerpa vesiculifera* and *Sargassum heteromorphum,* species with a Flindersian distribution, and *Cystophora monilifera,* a species widespread in southern Australia. Although not recorded on the transects, seagrass beds were found adjacent to the sites in the sheltered embayment on the eastern shore of Hogan Island

Habitat: The majority of available reef habitat at the Hogan Group consists of deep reef, with only a limited area of shallow exposed reef available. A small area of shallow reef with slight to moderate exposure exists, the majority of which can be found in the embayment on the eastern side of Hogan Island. This is an area with adjacent seagrass habitat.

Summary

1. A range of habitats are available within the Hogan Group although the extent of sheltered to moderately exposed reef is limited.
2. The biota present included 16 species whose Tasmanian distribution was limited to Bass Strait. These included 7 species with a widespread southern Australian distribution, 5 species with a Flindersian distribution, and 4 species with a Peronian distribution.
3. The abundance of *Centrostephanus rodgersii,* a typically Peronian species, the significant presence of Peronian fish species, and the presence of *Dactylophora nigricans,* a species now rare in Tasmanian waters, were the most notable features of this survey.

Kent Group

The Kent Group of islands is situated approximately half way between Wilsons Promontory, Victoria and the northern end of Flinders Island. The group consists of 3 large islands, Deal, Erith and Dover; 2 small islands, North East Isle and South West Isle; as well as a number of rock

outcrops (Fig 8). These include Judgement Rocks (Fig. 9), the site of Tasmania's largest breeding colony of fur seals. Dover and Erith islands are partly cleared and are grazed by cattle. Deal island is presently owned by the Commonwealth of Australia and, until 1991, was the site of a manned lighthouse. This has now been decommissioned and the island is inhabited by a caretaker until the fate of the island is determined. Murray Passage is a safe all weather anchorage, although deep in places (to 40m) and subject to strong currents. Safe landing beaches occur on Erith Island in East Cove and on Deal Island in West Cove, where a jetty is also situated. A more detailed description of this group is given by Edgar (1984).
This survey was intended to build on the results of Edgar, to gain a more quantitative appraisal of the Group, and investigate further sites within the area.

Fish: A total of 48 species of fish were identified during the fish transects at the Kent group (table 6), while a further 4 species were encountered during the invertebrate survey (table 7). The total species present per site ranged from 4 to 34. On average the diversity of species per site was far in excess of that encountered during the north coast survey. The two low values of 4 and 10 were at sites 5 and 6 (Fig. 8) which were surveyed to determine the impact of a fur seal colony on the reef biota. The lowest value (4) was at Big Rock, the site of the seal colony itself, while the count of 10 was at the nearby South West Isle, where seals were still plentiful in the water but were not present ashore.
Notolabrus tetricus, Notolabrus fucicola, and *Cheilodactylus nigripes* were present at all sites and abundant at most. Due to the diversity of habitats surveyed throughout the Kent Group and the impact of the Judgement Rocks seal colony at sites 5 & 6, the remaining species, while often locally abundant, were not shared by all sites. Some of the more abundant species included *Penicipelta vittiger, Odax cyanomelas,* and *Caesioperca rasor. C. rasor* was exceptionally abundant at some sites, with in excess of 1700 individuals being recorded at site 7. This appears to be in response to the presence of extensive areas of *Centrostephanus rodgersii* urchin barren habitats which are common at many sites throughout the Kent Group. Of the 52 fish species encountered during the survey, 34 species were those with a widespread Tasmanian distribution, while 18 species were those either those not recorded from Tasmanian coastal waters at all, or whose southernmost distribution extended to the Tasmanian

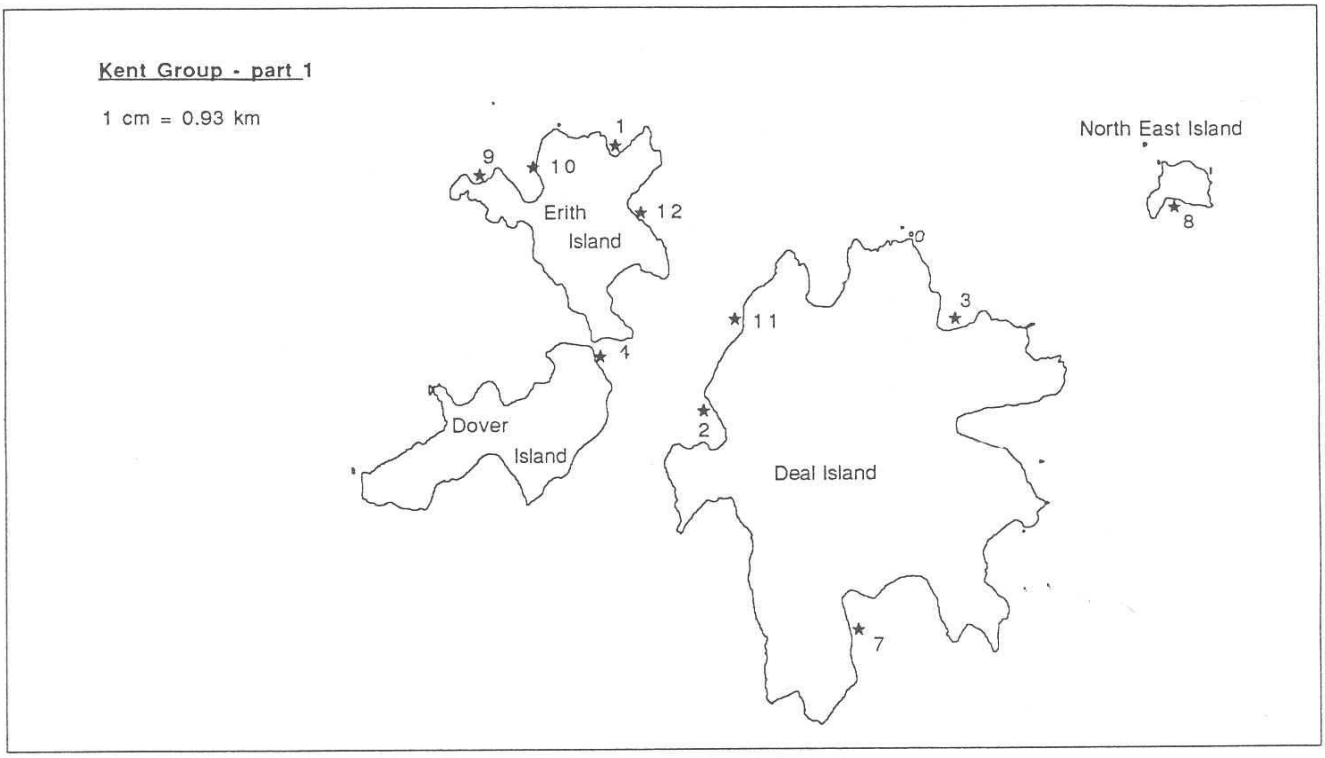


Figure 8. Location map of sites surveyed in the Kent Group, excluding sites 5 and 6, which are shown in Figure 9.

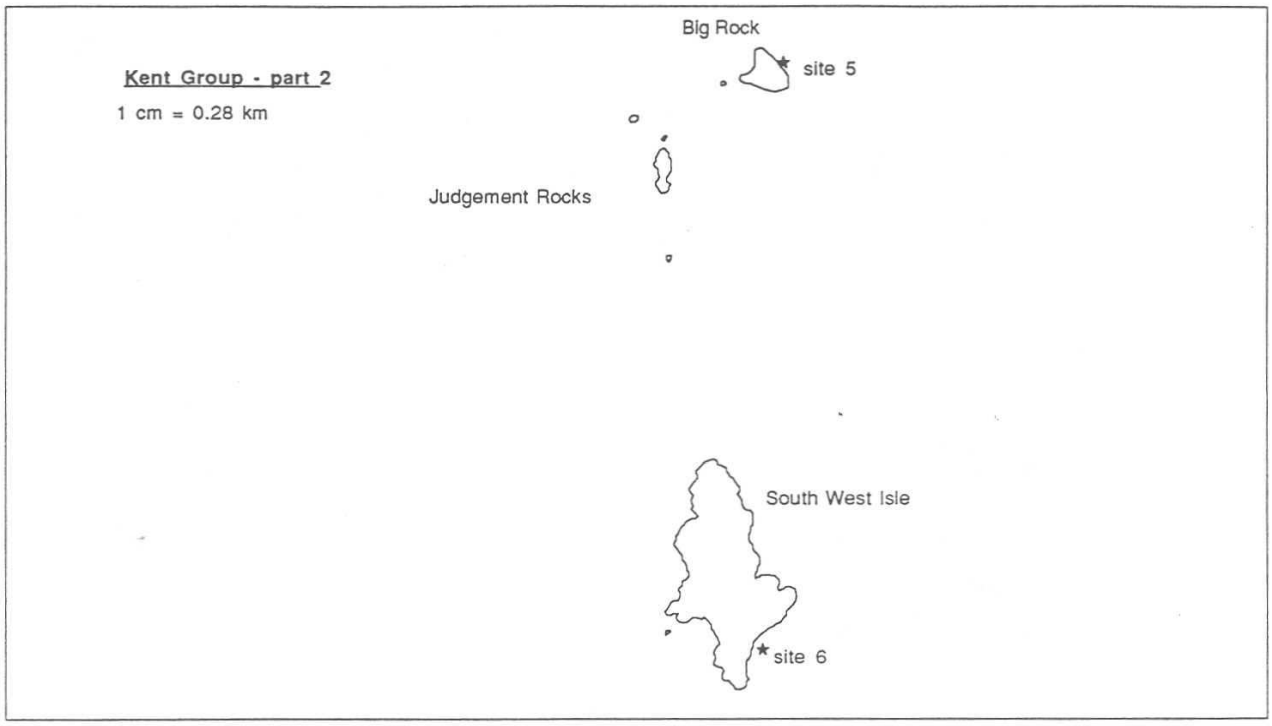


Figure 9. Location map of sites surveyed at Judgement rocks in the Kent Group of islands.

north coast. These northern species included *Meuschenia flavolineata, Odax acroptilis, Cheilodactylus nigripes, Enoplosus armatus, Scorpis aequipinnis, Melambaphes zebra, Kyphosus sydneyanus, Meuschenia venusta,* and *Hypoplectrodes nigrorubrum,* species with a widespread southern Australian distribution; *Opthalmolepis lineolatus, Parma microlepis, Chromis hypsilepis, Atypichthys strigatus, Girella elevata,* and *Ellerkeldia maccullochi,* species with a Peronian distribution; and *Parma victoriae,* a species with a Flindersian distribution. Many of these are uncommon or not recorded in Tasmanian coastal waters, indicating that the Kent group biota is under strong Peronian influence, much more so than the other locations covered by this survey of those of Edgar (1981, 1984). While the abundance of northern species partly explains the unusual species richness of the Kent Group fish fauna, 34 species with a southern distribution were also found, and this is far in excess of that found at any other location covered by this study. Much of this is likely due to both the extensive range of habitats found within the Kent Group, and also the isolation of this group which has protected its fish fauna from the amateur and commercial gillnet fisheries which have been implicated in the degredation of fish stocks in Tasmanian coastal waters.

Invertebrates: 23 species of invertebrates were encountered during the Kent group survey (table 7), with the number of species encountered at each site ranging from 7 to 14. *Heliocidaris erythrogramma* and *Haliotis rubra* were present at all sites and abundant at most, while *Centrostephanus rodgersii* was locally abundant. This Peronian species forms large urchin barrens on areas of moderately sheltered waters, and at depths where wave action is reduced. At some locations in Murray Passage, large areas of reef are devoid of macroalgae from depths of 4m down to the edge of the reef due to grazing by this species. Of the 23 species encountered, only 4 were species with their Tasmanian distribution restricted to the north coast. The northern species included *Haliotis laevigata, Nectria macrobranchia* and *Plecaster decanus,* species with a southern Australian distribution, and *Centrostephanus rodgersii,* a species with a Peronian distribution. The abundance of *C. rodgersii* indicates that these islands are under significant Peronian influence.

Macroalgae: A total of 40 species of macroalgae were encountered during the Kent Group survey (table 8). This is similar to the high value of 37 species encountered at Rocky Cape and is indicative of the wide range of habitats available within the Kent Group. *Phyllosphora comosa* was abundant at sites exposed to prevailing southerly and westerly winds and swells, while species such as *Cystophora moniliformis* and *Sargassum vestium* were abundant at sites with less exposure. One notable feature of the algal survey was the abundance of *Macrocystis angustifolia* at sites 5 and 6, and its total absence from the remaining sites. The abundance of this species appears to be nutrient related, and it is possible that nutrients released by the adjacent seal colony are responsible for the maintenance of kelp forests at these sites.

Of the 40 species of algae encountered during the survey, the majority have a widespread Tasmanian distribution, while 4 species have Tasmanian distributions restricted to the north coast. These included *Macrocystis angustifolia, Sargassum heteromorphum,* and *Caulerpa vesiculifera,* species with a Flindersian distribution, and *Cystophora monilifera,* a species with a widespread

southern Australian distribution. Unlike the fish and invertebrates, there was no obvious Peronian component to the macroalgal assemblages of the Kent Group.

Habitats: A wide variety of habitats were encountered during the Kent Group survey. In Murray Pass itself there are sheltered deep and shallow reefs, some of which are exposed to strong currents with communities dominated by filter feeders. Large areas of urchin barren also exist in Murray Passage, and present a unique habitat in themselves, supporting large densities of planktivorous fish and extensive sponge gardens rarely found in shallow water due to competition with macroalgae. As well as reef habitat, Murray Pass also contains areas of seagrass, some of which extend to depths in excess of 20m due to the unusual clarity of water at this location. Outside Murray Pass more exposed habitats are found, with the most exposed sites being situated on the western coasts of the islands. While much of the outer coastline is limited to deeper water, there are a number of embayments offering shallow reefs such as site 7 at Squally Cove, Deal island, where the highest fish diversity of the entire survey was recorded. Because of the granitic origin of these islands, the reef topography is often structurally complex, with large boulders and numerous caves, and this adds to the range of habitats available at any site.

Summary of Kent Group survey.

1. The Kent Group encompasses a diversity of habitats within a small area, including, shallow and deep sheltered reef, deep and shallow exposed reefs, and areas exposed to strong currents. The *Centrostephanus rodgersii* urchin barrens provide a unique habitat not found elsewhere in Tasmanian waters, and likewise, the deep seagrass beds in Murray Passage also comprise a habitat uncommon in Tasmanian waters.
2. The diversity of fish species is significantly higher than any other area covered by this survey and may be the highest of any Tasmanian waters, with the fish fauna in pristine condition as it is essentially protected from gillnet fishing due to the isolation of this location.
3. There is a significant Peronian component to the fish fauna, far in excess of that found elsewhere in the Bass Strait region, making this a unique zoogeographical location, at least amongst the locations investigated during this survey and those of Edgar (1981, 1984)
4. Any reserve in the Kent Group would need to include the unique urchin barren and deep seagrass habitats available in Murray Passage, as well as a number of exposed shallow reef areas such as Squally Cove, Deal Island, as these contain fish communities of unusual diversity, abundance, and biogeographic affinities..

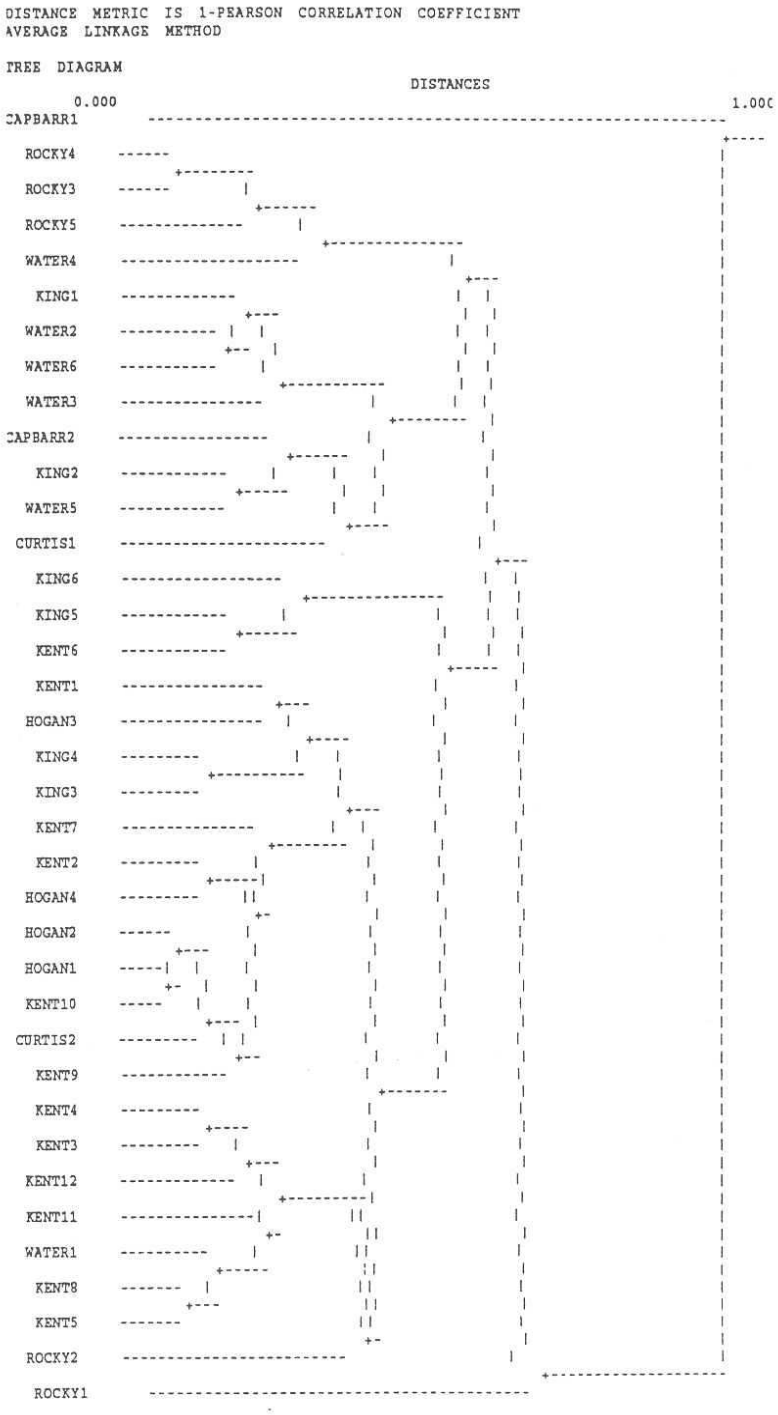


Figure 10. Cluster analysis of fish data comparing similarity of sites surveyed in Bass Strait. Analysis uses Pearson method with single linkage on log transformed data.

Discussion

The essential criteria of an integrated marine reserve network include:
1. Reserves be representative of each of the major biogeographic regions of Tasmania.
2. Reserves encompass the full range of biotic assemblages present in each region.
3. Reserves be of sufficient size to maintain a significant proportion of the resident populations of fish, invertebrates, and algae.
In an earlier survey of potential reserve sites in Tasmania, Edgar (1981,1984) identified Maria Island, Rocky Cape and the Kent Group of islands as the sites most likely to fulfil these criteria, and developed detailed proposals of reserve boundaries and regulations. While a network of small reserves have now been established in Eastern and South Eastern Tasmania, protecting many of the biotic assemblages typical of the Maugean (Southern Tasmanian) biogeographic province, no reserves have been established to protect representative areas of northern Tasmania under Flindersian and Peronian influence.

This present survey investigated the Tasmanian north coast and Bass Strait islands to identify any alternative sites to those suggested by Edgar (1981,1984) and to re-evaluate the Rocky Cape and Kent Group sites selected during the previous survey. Of all the locations investigated, the Kent Group was the most outstanding. The fish diversity and abundance was exceptional, whether measured by the species present per site, or by the Shannon diversity index, with the average value per site far in excess of that encountered elsewhere. A diverse range of habitats occur within the Kent Group, encompassing most of those typical of the region, and including *Centrostephanus* urchin barrens and deep seagrass beds, two habitats rare or unique in Tasmanian waters. This was the only location with a high proportion of Peronian species and is the natural selection for a regional reserve to protect species and habitats within this biogeographical region. As well as having a significant proportion of Peronian species, most of the species encountered during the entire survey were found within the Kent Group, hilighting this locations suitability as a regional reserve.

While a major regional reserve at the Kent Group is a high priority, affording protection to many marine floral and faunal communities representative of the Flindersian and Peronian influenced waters of Tasmania, it lacks some examples of inshore habitat and has restricted public access. The only suitable regions which offer these, are the Rocky Cape to Jacobs Boat Harbour section of coastline and the Waterhouse Point to Cape Portland section .
The Rocky Cape to Boat Harbour coastal section offers a diversity of inshore habitats which are representative of the Tasmanian north coast and are enhanced by the structural complexity of most of the reef. The survey results show fish diversity and abundance in this region to be second only to the Kent Group, indicating its biological suitability as a reserve location. The area of reef coverage is

extensive, allowing for establishment of a reserve of sufficient size to be biologically self sustaining, and excellent public access is available.

The Waterhouse Point to Cape Portland region had a more restricted range of habitats than those found at Rocky Cape, with most inshore habitats restricted to shallow reefs of 5m depth or less, subject to slight to moderate exposure. The most favourable location within this region was Waterhouse Island which offers a much wider range of habitats than those found on the nearby Waterhouse Point coast, including exposed deep reef on its western shore and sheltered seagrass on its eastern shore.The biological diversity of the sites surveyed at Waterhouse Island appear similar to the average of Rocky Cape, and the reef area surrounding the island appears sufficient to create a reserve of suitable size. As this Island lies 2km offshore, a reserve surrounding it would also need to extend to Waterhouse Point on the Tasmanian coastline if easy public access was an important factor in reserve site selection.

King Island also offers an extensive area of reef that may be suitable for a western Bass Strait reserve; however the only location that offers the diversity of habitats necessary for an effective reserve was at New Years Island, off the northwest coast of King Island. This location was somewhat similar to Waterhouse Island, with habitats ranging from exposed deep reefs on its western shore to sheltered areas of seagrass on its eastern shore. The fish diversity and abundance at this location was similar to the average of Tasmania's north coast and well above average for King Island. A reserve here would need to encompass both New Year Island and the adjacent Christmas Island to provide an adequate area of suitable reef.

Conclusions

The process of choosing a marine reserve site is a balance between biological suitability, public access and public acceptance. If representative marine reserves are to be established in the eastern and western Bass Strait region, then the choice of the Kent Group for a reserve in eastern Bass Strait is inevitable. Biologically it is an outstanding location, representing a diversity of habitats some unique to Tasmanian waters, it has a significant Peronian component to its biota and has a pristine reef fish population of exceptional diversity. These factors outweigh any consideration of public access, and public acceptance should be high due to its isolation. Waterhouse Island should be concidered as a second reserve location in eastern Bass Strait, representing coastal habitats not encountered at the Kent Group, and providing a reserve with easier public access.

In western Bass Strait the choice is more difficult. Rocky Cape is the most suitable location on biological criteria and it has excellent public access; however public opposition can be expected

from the recreational fishermen who presently use this area. The alternative location at the New Years Islands off King Island, offers a suitable location on biological criteria and may arouse less public opposition, however it is a remote location with no easy access.

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